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CONTENTS.

ARTICLES. PAGE

1. Witchcraft, Insanity, and Crime. By FRANK FERNSEED 505
2. Bestiarianism *v.* Common Sense 512
3. Jottings on Odours, and their Recognition. By J. W. SLATER 519
4. Agricultural Possibilites. By AN OLD TECHNOLOGIST .. 525
5. Will-o'-the-Wisp again. By W. MATTIEU WILLIAMS .. 533
6. Experimentation in Biology. By OSWALD DAWSON 535

ANALYSES OF BOOKS.

A Treatise on the Distillation of Coal Tar, &c. 54

ANALYSES OF BOOKS—*continued.* PAGE

Vignettes from Nature 546
The Life of Charles Darwin, with British Opinion on Evolution 549
A Dictionary of Popular Names of the Plants which furnish the Natural and Acquired Wants of Man in all Matters of Domestic and General Economy, their History, Products, and Uses 551
The Field Naturalist and Scientific Student 553
Le Monde Animal 554
&c., &c.

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XUM

THE

JOURNAL OF SCIENCE.

SEPTEMBER, 1882.

I. WITCHCRAFT, INSANITY, AND CRIME.*

By FRANK FERNSEED.

IT is undeniable that the last word concerning witchcraft has not yet been said, and is scarcely at present even to be expected. After having filled for centuries an important part in the beliefs of our ancestors, and having left its dark-red stain on the records of their social life, of their legislation, and of their jurisprudence, it was consigned to the limbo of forgetfulness as an exploded delusion, an odd mixture of madness and imposture not worth the serious notice of any enlightened man. In this estimate it was forgotten that even the wildest misbeliefs are psychological facts deserving careful study, and, further, that the possibility and the actual occurrence of witchcraft have never been formally disproved. To do so, in fact, would require a demonstration either that no spiritual beings exist, or that, if existent, they have no power to interfere in human affairs. We may perhaps believe these propositions, but how are we to establish them to the satisfaction of the candid doubter?

Furthermore, there has been a "turn of the tide," in virtue of which not a few thinkers, men of learning and reputation, admit that incorporeal and ordinarily invisible beings, whether parastatic spirits or the ghosts of defunct

* The Psychology of the Salem Witchcraft Excitement of 1692, and its Practical Application to our Own Time. By G. M. BEARD, A.M., M.D. New York: G. P. Putnam's Sons. London: Trübner and Co.

The Case of Guiteau: a Psychological Study. By G. M. BEARD, A.M., M.D. New York.

The Problems of Insanity. By G. M. BEARD, A.M., M.D.

men (and beasts?), may affect the living either for good or evil. These views, indeed, are by no means accepted by Dr. Beard. He speaks of Spiritualism, Animal Magnetism, and Mind Reading as delusions which have been welcomed in Europe after having been "exposed and shorn of their force in America." Or again, speaking of the accusers of the alleged Salem witches, he says—"Out of such a circle as this developed the spirit-rapping excitement at Rochester, which was the modern evolution of witchcraft known as Spiritualism: in such circles the Eddy Brothers, in my presence, recently raised the dead, and Katie King appeared in human form. If this Salem circle of afflicted children had possessed the rapping power with joints that the Fox girls possessed; if they could have read muscle like 'Brown the mind-reader' and his disciples; if they could have achieved any of the slate-writing tricks of modern mediums, their power for evil would have been titanic." But this very reaction against the possibly too-sweeping scepticism of the first half of the present century, which Dr. Beard here denounces, is a reason for a thoroughly scientific study of the subject. Until such study has been completed witchcraft must continue to have more than a mere historical significance. This being, however, admitted, I must presume to differ from Dr. Beard on some points not without importance. He attaches to the New England witch-mania of 1692, and its deplorable cruelties and murders, an importance which they can scarcely claim. He tells us that "the twenty victims of the Salem judicial massacres were nearly the last of the immense army of murdered witches"; that "England in 1692 would not have executed twenty of her citizens for witchcraft"; that "it was the last act in the long tragedy of terror and blood"; and that the "erroneous belief" in sorcery "starving for want of pasture in Europe" experienced in New England a transient recovery. Dr. Beard here pays Europe too high a compliment. If the testimony of Dr. Parr is to be believed,* two witches were executed at Northampton in 1705, and in 1712—twenty years after the Salem tragedy—five more suffered capitally at the same puritanical town. In Scotland a victim was put to death in 1722. The sub-prioress of a nunnery† suffered execution by fire at Würzburg in 1749; and one Anna Göldi perished at the stake at Glarus, in Switzerland, as recently as 1781—the horrors of mediæval ignorance thus almost blending with those of revolutionary enlightenment!

* Buckle, History of Civilisation, i., p. 333.
† Horst, Zauberbibliothek.

It is therefore not easy to recognise the Salem murders as "the last struggles, the death-rattle of the monster that had been wandering for centuries wild over Europe." They were merely one scene in its decline.

In order "to answer the question why the last bloody battles of witchcraft were fought on American soil," Dr. Beard considers it necessary to "know something of the intellectual character of the American people, and of the race to which they belong." His remarks on this subject are so interesting and suggestive that I quote them, even after having shown that the last dying struggle of witchcraft took place elsewhere :—

"The Anglo-Saxon peoples in both Europe and America have, in modern days, a genius for non-expertness in Science. That we might preserve our political freedom we have in other directions become as slaves bound in time-rusted chains of common delusions ; we have sacrificed almost everything else that we might have liberty." Parenthetically I remark that this "political freedom" may prove to have been dear at the price. "Were we not," he resumes, "constantly nursed at the breast of Germany, both England and America would long since have starved to death scientifically." I fully admit here that in the number of sound scientific workers, and consequently in the quantity of research produced, we are far inferior to Germany. But Faraday and Darwin may serve as sufficient instances to show that our deficiency lies not in any in-bred peculiarity of race, but in artificial circumstances, which at present drive or tempt all our best minds away in other directions, and which it is, to a great extent, within the power of the Government to alter. I refer, *e.g.*, to the possibility of appropriating University fellowships as the reward of successful research.

Dr. Beard continues :—"This genius for scientific non-expertness is attended by a genius of almost equal power for intellectual timidity. Of all great peoples the English-speaking peoples are the most cowardly in the face of ideas : of such were our ancestors in England and New England ; of such, in fading degree, are we at this hour. The one prayer of the puritan mother, that her child should never learn to think, has been answered, and thus far America has given no philosophy to the world." Has Spain, or has Russia ? To continue my quotation :—"With all our opportunity, with all our advance, no other enlightened nation has expended so much cerebral force in the emotion of fear as has America. Always our fathers were kept on the run before new truths ; they would be above the suspicion of

Science. Instinctively, as chickens run with cries from the shadow of a hawk flying high in the air, these puritans ran at the approach of new truths, hiding themselves in trembling terror under the broad wings of the church."

Here, then, we have a new count, not to be omitted when the indictment of puritanism is being drawn up. That she has been a poison to the æsthetic life of the nation, deadly to high art and to poetry, is to some extent admitted. That she has been no less baneful to Science and Philosophy is a grave aggravation of her guilt. But yet again, I must ask is the "approach of new truths" viewed with terror only, or even mainly, in England and America? I have heard of and met with Alethophobia, a feeling far from rare wherever there exist cliques of official *savans* who "show great reluctance to change old erroneous notions, and very often write in order to suppress what is not in accordance with their ideas."

Dr. Beard views witchcraft as an essentially morbid, pathological phenomenon, devoid of any subjective basis. Hysterical persons in an ignorant age believe their sufferings, real or imaginary, to have a personal external cause—the ill-will of spiritual beings, or of human neighbours supposed to be in league with spirits. Such persons are the "afflicted," the accusers and witnesses. They are generally young females mutually well acquainted, and given to fostering the delusions of each other. The accused, the so-called witches, are not unfrequently also hysterical, or even insane, and appear in some cases to have believed themselves in league with spirits and in possession of supernatural powers. There are, however, some curious circumstances connected with the selection—as it may be called—of victims, and these circumstances point to an element of imposture, deception, and even malignity. Why, else, were accusations of sorcery brought, both in Europe and America, pre-eminently against the unpopular, the poor, the uninfluential? In Catholic countries the imputation of witchcraft was closely connected with the charge of heresy. In New England the first victims accused were persons of mean estate, unprotected, and who had probably drawn unpleasant attention upon themselves by some harmless eccentricity of conduct, or even by some peculiarity of appearance. But at Salem, as elsewhere, the accusers were emboldened by success, and struck higher. This presumption in many places put a check to the judicial murders. When nobles, judges, clergymen, military and naval officers of rank, or their wives and daughters were denounced as sorcerers the authorities were

startled, and the public in general began to ask the question, "Who is safe?" In short, the witch-massacres came to an end much on the same principle as did the "reign of terror" in the first French Revolution.

A prominent feature in Dr. Beard's treatment of the question of sorcery is the parallel which he attempts to draw between the Salem witch-trials and the recent condemnation of Guiteau. Both, he considers, turned upon insanity. He admits one important distinction,—*i.e.*, that in the Salem inquisitions the insanity was on the part of the accusers and witnesses, whilst in the recent transaction at Washington it was on the part of the accused. He fails, however, to note a distinction which to me seems all-important. No one doubts, or could doubt, that President Garfield was murdered,—or killed, if the term murder is objected to. Nor could any one deny that Guiteau, taken as he was "red-handed," was the man who fired the fatal shot. But in the witch-trials the case was totally different. Suppose Ann Putnam, one of the "afflicted," really felt unpleasant symptoms, which were described as choking, pinching, biting, and generally tormenting, there was no proof that these phenomena had any outward objective cause at all! Still less was there any proof that the person accused had any more connection with these alleged sufferings than any other of the thousand million inhabitants of the globe. There was indeed testimony,—*i.e.*, assertion,—but it was utterly unsupported by facts. Great weight was laid upon the so-called "spectre evidence." If one of the accusers swore that she had seen the spectre of the accused in the form of a bird or beast, this was deemed, or dreamed, proof that the defendant was a sorcerer! Hence the parallelism between, say, Mrs. Nurse and Guiteau is not of the closest or most accurate. The latter suffered for a deed actually committed, and committed by him only; the former was done to death for an imaginary deed, with which she had no demonstrable connection.

Dr. Beard's views on the position of the insane before the law are peculiar, perhaps in some extent dangerous. He holds that "no more than children, no more than animals, can they be legally punished." Surely anything which is a peril to society not only may, but should be, eliminated—the idea of punishment being totally irrelevant. The assassin is like an infectious cesspool. We do not punish the latter, but we incapacitate it by disinfection from doing further harm. Just so with the murderer; public security demands his elimination, and whether that elimination take

the form of the gallows or of perpetual imprisonment is a secondary question. The essential points are that he shall not have the opportunity of repeating his offence, and that, in view of the heredity both of insanity and crime, he shall on no account be suffered to become a father.

As regards animals they are not, indeed, in these days arraigned before courts of law, but they are frequently punished for their offences, and the dread of punishment weighs with the more intelligent domestic species—horses, dogs, even cats—as a powerful motive in deterring them from actions to which they are otherwise inclined. Even elimination is, pending that "emancipation" of animals of which some hysterical spirits dream, the recognised doom of individual brutes which have committed some grievous outrage, and indeed of entire species which have been found perilous to man's person or his property. The tiger and the wolf cannot help, in virtue of their very nature, preying either upon our flocks and herds or upon ourselves; but this plea renders their extirpation all the more imperative.

The following doctrine seems to me fraught with grave dangers:—"It will be held that a lunatic may be capable of making wills and contracts, and of giving testimony in court, even if not responsible for any offence he may have committed."

It is important to note that Dr. Beard fully admits that the plea of insanity has been abused to the acquittal of the guilty, who have thus not merely escaped the scaffold, but have been turned loose upon the world again. He writes:—"The psychology of the future will not admit the plea of insanity except for those who are seriously sick in mind, and who manifest their insanity by decline in the instinct of self-preservation (it is declining in the people of England, *pari passu*, with the tribal instinct), and in the power of adapting themselves to environment, by important moral decline or by lack of rememberable consciousness; simple eccentricity, or hypochondria or hysteria, or morbid impulses or morbid fears, will not be regarded as diagnostics of insanity." It must be admitted that Psychology will have to make great progress before experts cease to differ on such delicate distinctions.

Returning to the main subject, it will astonish not a few to learn that "at this very hour, in and around Salem and adjoining Massachussetts towns, witchcraft is cherished by the sons and daughters of these Puritans: they may not know or confess that they are believers in the delusion, and the fact of such belief would only be brought out by close

cross-examination, which I have sometimes made; but in this doctrine, the root, the basis, the life, the soul of witchcraft, —that the devil enters into and takes possession of men, and binds them over to himself,—they have made no advance, or but little advance, over their Puritan ancestors of 1692."

There is much of deep import in the following remarks on the commingling of delusion and imposture:—"In psychology, if not in theology, the doctrine of the trinity is verifiable; in a single person we shall find the deceiver, the partially deceived, and the wholly deceived; three in one and one in three; unity in diversity and diversity in unity; an engrafted tree bearing varied fruits all nourished from a common trunk, and rooted in the soil of superstition. We are often deceived when we suppose we are deceivers—dupes even more than charlatans." However widely the reader may differ from some of Dr. Beard's fundamental views, he cannot fail to recognise the fearful truths conveyed in this passage.

Not less significant is the author's comment on the part played by witchcraft in the education of our race:—"Delusions are not only inevitable, but they are indispensable to mankind. Our planet is ruled, is destined to be ruled, by the imagination. The world can do without science—the demonstrably true; few indeed have any science, and those few but little; the world can even exist for a time without religion, or with almost none; the demonstrably false it will not and cannot do without. Witchcraft, bloody and terrible as it is, has probably been of supreme service to civilisation, if indeed it be not a part of the very foundation of all our culture. Our not very far distant ancestors were coarse and brutal savages who must be frightened into the pathway of civilisation; and for such the belief not only in a personal and ever-present God, but in a personal and ever-present, or liable to be present, Devil was requisite. Says Varro—'It is necessary that the people should be ignorant of many things that are true, and believe many things that are false.'"

At least, whether necessary or not, it is the case not less now than heretofore.

II. BESTIARIANISM *v.* COMMON SENSE.*

(Concluded from page 460.)

IN our last issue we showed the utter and fatal inconsistency of those persons who condemn physiological experimentation, and who yet make themselves, personally or by proxy, parties to the infliction of restraint, pain, and death upon animals on an incomparably—we might almost say infinitely—larger scale. We turn now to those who at least strive to be consistent, and whose object is the emancipation of animals alike from the scientific experimentalist, from the sportsman, the angler, the butcher, the castrator, the horse-breaker, and driver. Whether any living person really takes this point of view in its entirety, after a full consideration of what it involves, may be doubted. We have heard of persons who mount the anti-vivisectionist platform, who eschew animal matter for food and clothing, and who reject "sport" in all its branches. But they still employ the forced labour of animals; they would cultivate the ground, although in so doing they must destroy—as Mr. Mattieu Williams reminded them in a recent issue of the "Journal of Science" (p. 396)—myriads of animals, and if troubled either with *Epizoa* or *Entozoa* they would not scruple to apply, in the one case, Persian powder and the small-tooth comb, and in the other anthelmintics. Consequently such persons must either admit of arbitrary exceptions to their creed of animal emancipation, or they must make themselves a party to their own extirpation and that of their species. If we cease feeding upon oxen, sheep, hares, rabbits, &c., we must make an end of them; for when no longer to be made subservient to our purposes they become simply enemies, who, if they do not attack us personally, wage war against us by occupying and spoiling the ground, and by consuming the fruits of the earth. Even now the competition between man and man renders it difficult enough for men to live. What will be the case in

* Experimental Physiology, its Benefits to Mankind. By RICHARD OWEN, C.B., M.D., F.R.S., &c. London: Longmans.

The Uselessness of Vivisection upon Animals as a Method of Scientific Research. By LAWSON TAIT, F.R.C.S. Birmingham: Herald Press.

The Ethics of Vivisection. By Dr. S. WILKS. Contemporary Review.

214 years, when, as statisticians tell us, the human population of our globe will amount to an average of 700 persons per square mile of its whole surface? Can we afford to give up millions of acres to be the haunt of wild horses, cattle, and swine, and to be drilled and undermined by rabbits? Unless self-preservation ceases to be either the first or the last law of our nature we must reply to the advocates of animal emancipation with a stern *non possumus*. We must refuse to commit racial suicide. There is a legend of an Indian saint who gave his own body to preserve the life of a famishing tigress, and we have seen the deed extolled as an instance of self-denial. In reality it was a grievous crime. If the tigress preserved by his sacrifice slew afterwards any other human being he was constructively, but not the less decidedly, a murderer.

Surely, then, summing up the foregoing considerations, it may be said that the Bestiarian position is every way untenable. Unless they refrain entirely from giving pain to animals they are inconsistent; if they do so refrain they cannot exist.

Having thus cleared the ground we may come to an examination of Mr. Lawson Tait's pamphlet. His opening remarks on the needlessness of vivisection for purposes of demonstration we may at once dismiss as foreign to his and our purpose. We then come to the following strange passage:—"The position of vivisection as a method of scientific research stands alone amongst the infinite variety of roads for the discovery of Nature's secrets as being open to strong *prima facie* objections." We reply that there are but two such roads, observation and experiment; if the latter is closed to the investigator in animal physiology he will indeed, among all students of Science, stand alone. If we ask what is the strong *prima facie* objection, we find it consists in "a strong and widespread public sentiment"—more accurately described as an artificially created public prejudice or delusion—and the alleged uncertainty of the results. Says Mr. Lawson Tait:—"No one can urge the slightest ground of objection against the astronomer, the chemist, the electrician, or the geologist, in their ways of working; and the great commendation of all other workers is the comparative certainty of their results." But a short time ago no one objected to the physiologist, and no one certainly now can venture to guarantee that a popular outcry may not suddenly be raised against research in other departments of Science. Whispers are already heard that the fanatical party will by no means desist from their agitation. Not to go into details,

it is actually hinted that experiments on hybridisation among plants will shortly be denounced on the score of "indecency"!

The results of the experimental physiologist are often, we are told, uncertain. It may naturally be expected that the more complicated the subject the more difficult must experimentation become. But is that any reason why we should desist from experiment when we have no substitute? Mr. Tait must be aware that in other sciences, also, self-contradictory—and therefore to some extent erroneous—results have often been arrived at, not merely by tyros and bunglers, but by men of established reputation. The truth, let us remind him, is not always readily and easily reached in physical and chemical experimentation. But the fact of this difficulty has always been felt by physicists and chemists to be the most urgent reason, not for the abandonment of experiment, but for its multiplication and repetition under varied circumstances. By acting on this principle the truth is ultimately reached.

We now come to Mr. Tait's "four avenues of thought," which seem to be four ways leading certain people to deny—or at least to doubt—the permissibility of physiological experimentation. The first of these is "the avenue of pure abstract morality, by which it is argued that we have no right to inflict sufferings on others that we ourselves may benefit." This "avenue," we reply, proves, if anything, far more than the public would care to hear. If we may not inflict sufferings upon others for our benefit, what right have we to kill animals for food, to force them to drag our carts and coaches, to emasculate them, or to destroy, rats, mice, bugs, cockchaffers, wireworms, slugs, and multitudes of other animals, large and small? Mr. Lawson Tait's first avenue, therefore, only leads into the quagmire of inconsistency in which the majority of "anti-vivisectionists" contentedly wallow. But we have yet to note a curious addition. Mr. Tait writes—"An avenue which is worthy of the highest respect, because its opening up is only a matter of yesterday, in the evolution of the moral life of individuals, and, as far as national morality is concerned, it can hardly be said to have been ever seriously considered until about a year ago."

We have always been of opinion that truth, whether new or old, was equally valuable. But we must utterly scout the contention that a doctrine deserves the more respect from its novelty. A man was sane until about a year ago: recently he has become deranged. Are we to hold his present notions of value simply because they are only a "matter of

yesterday"? Yet to this conclusion Mr. Tait's line of argument must lead us. We fear he forgets that Evolution is not always a movement upwards, so that the recent is not to be pronounced *ipso facto* superior to the old.

We next come to a consideration so far-fetched, so altogether questionable in its essence, that we are compelled to quote it word for word, lest we should be suspected of misrepresentation:—

"The second may be called a political avenue, and is also one of importance, though that importance is not visible at first sight, and may even be altogether denied by some of a particular shade of political conviction. But to those of us who regard the Game Laws as a prolific method of manufacturing criminals, of wasting public money, of preventing the development of agricultural industry, and hindering the development of the peasant from his present serfdom to his possible and perfect citizenship, this avenue assumes a mighty importance when we discover that the lay support of vivisection is derived mainly from those who maintain costly pheasant preserves in order to become amateur poultry butchers, and who maim pigeons at Hurlingham under the idea that it is amusement. Anyone, therefore, who objects to the Game Laws from political conviction will put vivisection upon its trial, and he must hear a good case before he consents to an acquittal!"

This argument, if so it may be called, when stripped of its unnecessary and totally irrelevant verbiage, amounts to the contention that whatsoever a game-preserver or a member of a gun-club supports is, if not absolutely wrong, at least so suspicious that it must be compelled to prove its own innocence before it can secure its existence. Or if Mr. Tait's assertion be generalised it amounts to this, that whatever a political opponent supports must be regarded with hostility!" The morality and the logic of such a contention stand on the same level, and need no exposure. This "important" second avenue is, in short, an appeal to the "*odium politicum*," a weapon no less reprehensible than the now unfashionable *odium theologicum*. It may be, from one point of view, a clever strategical move to place "anti-vivisectionism" in alliance with a political party, and to propitiate the *genius loci*. But it is a step ill-becoming anyone whose aim, we would fain hope, is truth. We should like to know what is the evidence to prove that the lay support of physiological experimentation is derived mainly from game-preservers and Hurlingham heroes?* We have

* It must be noted that England is at once the focus of "sport" and of "anti-vivisectionism."

been under the impression that the sporting world had mainly, if not exclusively, enlisted under the Anti-Vivisectionist standard. The "Society" and the sporting-press are, to the best of our knowledge, against us. We have never seen a defence of physiological experimentation by any known, typical, game-preserver. We could give the names of fox-hunters, owners of buckhounds, battue-sportsmen, and anglers, whose sympathies are avowedly given to the Anti-Vivisection movement. Thus Mr. Froude, the eminent historian, a pronounced Anti-Vivisectionist, is not merely an enthusiastic angler, but a defender of sport in general, as may be seen in his article on "Cheneys and the House of Russell."

We deny, in short, that the lay support of "vivisection" is derived mainly from the sporting world, and even if this were accidentally the case we hold that it would prove nothing. The Game Laws, be their tendencies evil or good, —a question which it does not lie within our competence to discuss,—have nothing to do with the matter at issue.

Before leaving this unhappy "second avenue" we ask whether the Birmingham Philosophical Society has not, like most such bodies, a rule prohibiting the introduction of party politics? If so, how came such a breach of order to be tolerated?

Turn we to the third "avenue"—"the religious one." Here we read that "the doctrine of Evolution has affected religion, as it has everything else. Admitting that the so-called lower animals are part of ourselves, in being of one scheme and differing from us only in degree, no matter how they be considered, is to admit they have equal rights. These rights are in no case to be hastily and unfairly set aside, but should be all the more tenderly dealt with in that civilisation and inventions are every day making it more and more difficult for the animals to assert their independence, or as it were to vote upon the question!" To this strange perversion of Evolutionism we reply,—1st, by pronouncing Mr. Tait's assumption of "equal rights" to be no legitimate inference from the fundamental truths of the New Natural History; 2nd, that if animals have equal rights with man, so also have plants; and 3rd, that if it be wrong to experiment upon our "poor relations," not less is it wrong to eat them, to enslave, and emasculate them. As Dr. Wilks well points out, it is a standing error of Bestiarians to speak as if there existed "among the public some principle of conduct towards the lower animals which has no place among experimenters." And again, "If a horse could define his rights

would he admit the necessity of his going round in a mill the livelong day, or dragging a tram-car, with the never-ceasing jangle of bells in his ears?" If we look into Nature we find that every species has the right to maintain itself, and increase if it can, and in order to do so it must drive out, extirpate, or subjugate its competitors.

We come now to the last question, the value of physiological experimentation as a "method of scientific research." This is, in reality, the point which Mr. Lawson Tait, in the title of his pamphlet, undertakes to discuss. Greatly to our surprise he has not, in the strict sense of the words, even made the attempt. He does not refer to the many unsolved questions in physiology, and show either that they cannot be solved by experiment or that they can be preferably—or at least equally—well answered by some other method of research. He does not refer to pure biological investigation at all. On the contrary, he takes the following series of instances:—

I. Treatment of injuries of the head, and the theory of Contre-coup.
II. Amputation of the hip-joint.
III. Paracentesis thoracis.
IV. Subcutaneous tenotomy.
V. Treatment of aneurism, ligature, and torsion of arteries.
VI. Transfusion.
VII. Abdominal surgery.
VIII. Function of periosteum.
IX. The ecraseur.
X. The detection of poison.

In all these cases he attempts to show that the discovery had been made by someone else, or that it was practically useless, or that it was made without vivisection, or at least that vivisection played therein merely a subordinate part. Now admitting for argument's sake, as we can very well afford to do, that Mr. Lawson Tait is right in his contention, what has he proved? As regards the utility or uselessness of vivisection in scientific research, nothing! Not one of the instances which he discusses belongs to the region of pure biological inquiry, but, save the last, to practical surgery. In other words they are, or are supposed to be, inventions in practical art, not discoveries in speculative science.

We will make brief mention of some of the purely scientific questions which remain unsolved, and we will ask any

candid "anti-vivisector" how they can be solved without direct experiment? premising that if any other method can be devised we shall be not merely satisfied, but grateful:—

1. Connection, if any, between the physical and chemical properties of bodies and their physiological action. Is atomic weight related, directly or inversely, with toxic power? Do bodies chemically homologous produce effects of the same class when introduced into the animal system?
2. Discovery, in the lower animals, of the functions of certain organs—*e.g.*, the palpi of insects, arachnids, and crustaceans; the specific difference in function of simple and compound eyes, where both co-exist. Conversely, the localising of the different senses, and the detection, possibly, of new ones.
3. Determination of the causes which may determine, or at least influence, animal variability. Here belong experiments on the results of exposing animals for successive generations to abnormal thermic, luminous, or hygroscopic conditions; to higher or lower degrees of atmospheric pressure; to atmospheres of different chemical composition, or, in case of aquatic species, to water more or less charged with saline matter; to a modified diet, &c., &c.

We mention these instances not as an exhaustive catalogue, but simply as specimens. We are aware that while under all these heads good work has been done, yet very much remains undone, and we must plead our inability to see how a final decision can be reached without experiment. The vast majority of the experiments required would indeed be in all probability painless, involving no bodily lesion at all. Yet, so far as vertebrate animals go, they would be, in the present state of the law, unsafe. They might occasion "inconvenience," and, given a wealthy and ignorant prosecutor, an unscrupulous and ignorant counsel, and a fanatical and ignorant judge and jury,—commodities all easily to be met with,—the inconvenience might be construed as pain. Should the clamour of the enemies of Science prevail, we presume the same danger will be extended to inquiries on insects, mollusks, and still lower forms of life.

It may, or rather it will be, said that such experiments have no immediate utility, and merely serve to gratify our "curiosity," as the love of knowledge for its own sake is courteously called. Surely, we reply, it is at last time that we should rise superior to the stupid Philistinism of judging

truth by its immediate applicability and market-value. Of all the mistakes of our nation none is likely to cost us so dear.

Prof. Owen and Dr. Wilks have, each in his own department, done good service in combatting the Bestiarian mania. Mr. Lawson Tait has, in our opinion, completely failed in making out his case. We profoundly regret the tendency which he shows to import into the "vivisection" question the spirit of party politics.

III. JOTTINGS ON ODOURS, AND THEIR RECOGNITION.

By J. W. Slater.

THERE are some points connected both with the appreciation and production of odours of animals which seem to require further consideration. It is generally agreed that all species, possessing the sense of smell at all, like and are attracted by the odour of their usual food, or of substances of an analogous nature. We have also evidence that animals are agreeably impressed by the specific odour of their own species, or, in the case of widely-modified forms, of their own race or strain, and especially of individuals of the opposite sex. On the other hand, they are disgusted and repelled by the emanations of hostile species. These are the results which we might expect on evolutionist principles, and which we actually observe, whether we ascribe them to Prof. Jäger's soul-particles or not. At the same time we observe a few facts which we cannot well account for on the above-mentioned principles. I take as an instance the feline family. The natural food of all such creatures is, indeed, the flesh and blood of recently-killed animals; but in case of need they devour not merely carrion, but even excrementitious matter, and sometimes dig up the remains of the dead in cemeteries. We should naturally think that creatures capable of consuming such food must have preferences for odours not merely unlike, but totally

opposite to those which we approve; yet the fact remains that not merely the domestic cat, but the African leopard, and indeed all Felidæ whose manners have been closely observed, are passionately fond of many odours which man selects and enjoys. Lavender, thyme, marjoram, pennyroyal,—in short, almost all plants rich in essential oils,—have a well-known fascination for the cat. The leopard and the panther (if the latter is to be regarded as a distinct species) have been charmed into docility and submission by means of lavender-water. It is difficult to understand on what principle purely carnivorous species can be attracted by scents so totally unlike that of their food; I may add, so totally unlike that of the animals themselves. A feline animal must, as a matter of course, find nothing offensive in the smell of its own species, and it is hard to conceive how, *e.g.*, a leopard can tolerate the smell of its own species, and at the same time can have a craving for lavender-water. The difficulty becomes the greater if we consider that—at least as far as is known—nothing similar has been observed among the other groups of carnivorous animals, though one of them at least (the Canidæ) has a far more acute sense of smell than the Felidæ. With some hesitation I venture to suggest that the plants in question may act upon cats as an aphrodisiac. When these animals find, *e.g.*, a bed of thyme, chamomile, &c., they roll upon it, and indulge in demonstrations exactly like those which they manifest when under the evident influence of sexual excitement.

Prof. Jäger is of opinion that animals, man inclusive, are moved to fear or anger, as the case may be, by the odour of a hostile species. He maintains, with much probability, that the specific effluvium of a cat is offensive to mice, and causes them to avoid her presence and neighbourhood: that of the tiger, he considers, is in like manner exceptionally offensive to mankind. Now the odour of the tiger, the lion, and other of the larger Carnivora, is without doubt highly unpleasant; but I think a visit to the Zoological Gardens will convince anyone that many smaller animals, not personally dangerous to man, give off a still more disgusting and noisome effluvium.

In many cases an unknown or unaccustomed odour has a no less repellent effect upon animals than has that of a recognised enemy. Few beasts are at once more efficiently armed and more obstinately courageous than the grizzly bear, yet if he happens to approach a man from the leeward side, and detects his specific odour, without recognising its source, he withdraws in another direction. Many other and much

less formidable animals can only be approached from the lee side. Even in regions so solitary that the wild animals can have no acquaintance with man's peculiar effluvium, further than as a something unusual and inexplicable, they still take the alarm. Hence the hunter generally finds it necessary to proceed against the wind when in quest of his game.

This simple principle, the uneasiness caused by an unfamiliar odour, may serve to explain some facts which are very commonly put forward as manifestations of a mysterious "instinct." Thus in laying traps, poison, &c., for wild beasts and vermin, from the tiger and the wolverine down to the rat, the objects in question retain a smell of the human person. The intended victim, on approaching, recognises at once that he is in the presence of a something unknown, and he avoids the bait accordingly, or tries how he may obtain it without putting himself in peril.

Another very similar case is found in the felicity, if I may use the expression, shown by herbivorous animals in avoiding poisonous plants. Take an ox, a sheep, or a goat to a country where the flora is strange; he will browse upon plants analogous in odour with those which have formed his diet in his native country. But whenever he perceives a strange effluvium given off he avoids the plant as doubtful. The same mistrust of an unusual odour has been magnified in the following case into a mysterious instinct:—The authorities of the Jardin des Plantes, finding themselves overstocked with bears, resolved to get rid of one by poison, and for this purpose gave the destined victim a bun upon which some prussic acid had been poured. The bear, noticing the unusual smell, immediately pushed the bun into the water, and let it wash till the obnoxious odour had disappeared. There is not the least reason to suppose that Bruin had an instinctive knowledge of the effects of prussic acid, if swallowed.

All this will seem to us much more likely if we reflect that nearly all mammalian species far surpass us in the sensitiveness of their scent-organs. Besides this, they do not blunt these organs by the use of irritating condiments and so-called "strong" drinks. What a difference may thus be produced, in the sensitiveness both of smell and taste, I had once an opportunity of noticing in the case of a lady, who, having been for some years a sufferer from neuralgia, was advised to renounce all hot liquids and all pungent condiments, such as mustard, pepper, &c. After long perseverance in this regimen she acquired a delicacy both of

smell and taste which was astonishing to her friends. Her verdict as to the wholesomeness and purity of a water-supply was often of more than analytical accuracy.

But the lower mammalian animals have, as compared with man, a further advantage in the use of the sense of smell. Most of them can with ease bring the nose in contact with the ground, or with other low objects, which we can smell at only by dint of the tedious process of stooping, or by lifting the object up to our face. Hence, in virtue of the triple advantage above mentioned, they can at once decide if an enemy or a desired prey have recently crossed their path, and left its specific emanations on the ground or in the air. They live, in fact, in a world of odours, just as we live in a world of sights; and just as our eyes are always conveying to us information, so are they constantly receiving impressions through their noses. An unwonted smell, too slight even to attract our notice, is to them as significant as an inexplicable noise or a strange sight is to us. What wonder, therefore, if they are disturbed thereby, and at once put upon their guard?

A few remarks may be needful on the odours given off by animals. In some cases—as that of the skunk and the common water-snake—they are offensive and defensive weapons, consciously used under circumstances of danger. There are other cases where the specific odour may aid gregarious animals in finding their way back to their companions, or in recognising their mates of the other sex. But it is at least questionable whether, in some instances, the odour of an animal, whilst not powerful enough to repel enemies, may not serve to inform them of its presence, and put them upon its track. I have never been able to see what benefit the fox derives from his very strong odour. Let us suppose that a strain of foxes were to be developed in this country whose scent should be only one-fourth part as intense as that of the ordinary Reinecke: would not such strain, in virtue of the greater difficulty of following its scent, elude the hounds in a far greater number of cases, and in consequence be likely to gain ground upon, and ultimately to supplant, the ordinary loud-smelling breed? It may of course be argued that the scent of the fox does not expose him to any danger save the artificial one of a pack of hounds, and that fox-hunting has not been in existence long enough for a less odorous strain to be evolved.

The perfumes of plants, and especially of their flowers and fruits, were till lately left out of consideration as quite unaccountable, or were—what amounts to the same thing—

attributed to a perfectly arbitrary act of Divine will. Now a great approximation has been made to the truth of viewing both the odours and the colours of flowers as means for attracting such butterflies, moths, and birds as may aid in the process of fertilisation. It is further held, on the principle of natural economy, that colour and odour are mutually substitutes for each other. In fact this is what is observed in a multitude, perhaps in the majority, of cases. Many of the most brilliantly coloured and conspicuous flowers are scentless, whilst on the same principle many of the most richly perfumed blossoms are white or pale yellow.

But to this rule there are a number of exceptions which require serious consideration. Not a few flowers of a decided colouration are well known for their sweet smell. As familiar instances I may take the hyacinths, the sweet peas, the stocks and wallflowers, the pinks and carnations, the red rose, the oleander, the auricula, the cyclamen, and the violet. The last-mentioned flower is, however, very inconspicuous, and it is highly probable that it is indebted to its scent alone for the visits of bees. The original types of the auricula and of the wallflower were presumably the light yellow varieties we so often meet with. But though there are white oleanders, their original colour is in all probability red, and the same may be said of the pink and carnation.

We have also to deal with the fact that so many white flowers are totally scentless,—for instance, the large wild convolvulus, and the pear- and plum-blossom. This peculiarity may seem less perplexing if we consider that perfume must be more especially serviceable for attracting night-flying insect visitors, such as moths. Now the white convolvulus, like all its tribe, is a day-opening flower, and is always found tightly folded up at night. The white scentless fruit-blossoms open at a season of the year when few night-flying insects have made their appearance; consequently their fertilisation must depend on the visits of bees and butterflies. The questions then arise—Are any flowers which close at nightfall odoriferous? and, on the other hand, are any species which bloom only in the night scentless? These points can only be studied to advantage in tropical countries, where many flowers open and close at fixed hours of the day, as was shown in the "floral dial" drawn up by Linnæus.

Another interesting circumstance is the number of flowers which emit odours more or less offensive to our sense of smell. Among these rank many well-known garden favourites —dahlias, peonies, the tropæolums (commonly called

nasturtiums, tulips, most of the lilies, the geraniums, the French marigold, the sunflower, *Coreopsis Drummondi*, the spotted meadow-orchis, the elder-blossom, and many others. What is the especial function of these evil odours, and what enemies or unwelcome visitants do they repel? It must be noted, in the first place, that in perfume plants the stem and leaves are as a rule scentless, whilst the fragrance resides in the flower alone. Amongst the stench-worts, "if they will allow me so to call them," the whole plant is impregnated with the evil odour, which is sometimes less powerful and striking in the flower than in the leaves and stem. We are apt to conclude that because bees, butterflies, &c., are evidently attracted to some flowers which are pleasant to us, therefore they must necessarily dislike and avoid what to us is loathsome and repulsive. This is a most unsafe conclusion. The beautiful green rose-beetle is no less fond of the sickly-smelling elder-blossom than of the queen-flower whose name it bears. The most beautiful butterflies—"æsthetic aristocrats," as Mr. Grant Allen calls them—will turn from banquetting on the nectar of flowers to sip the drainage of a dunghill, or the juices of a putrid weasel or polecat, which to them may represent sauerkraut and venison. We do not, in fact, see that the ill-smelling flowers are in any signal way avoided by insects, whether enemies, such as the earwig, or those species which may aid in fecundation.

It may, perhaps, be safely said that the majority of unpleasantly-scented plants have flowers of a deep yellow, orange, brownish red, or brown colour, and that blue, pink, rose, lilac, and violet colours are very rare among them, save in case of artificially-produced varieties. A disproportionate number of such plants, further, belong to the family Compositæ, which, extensive as it is, scarcely includes a truly fragrant species. It can scarcely be denied that both pleasant and repulsive odours are respectively connected with certain families of the vegetable kingdom, and that the latter are preferentially correlated to certain colours and flavours.

IV. AGRICULTURAL POSSIBILITIES.*

By An Old Technologist.

THE appearance of a second edition of M. Ville's important work naturally leads to the discussion of some of the momentous questions raised by the author, and which have certainly not lost any portion of their interest since first propounded.

Agriculture, as we are told, or rather as we see, is in England in a most unsatisfactory position. A series of years wetter, colder, and windier than the average have rendered farming not merely an unremunerative, but a positively ruinous occupation,—a most serious state of affairs if we reflect that, after all the advance made in manufactures, the larger part of the national capital is invested in the cultivation of the soil. If that capital from year to year brings in no returns, and is even diminished by losses, it would be an insult to the common sense of my readers were I to expound at length what must be the ultimate result,—a result rendered the more certain by the fact that we no longer hold that unquestioned manufacturing and commercial supremacy which we once thought was, and must be for ever, our own. Were it not for the introduction of food in ever-increasing proportions from abroad, especially from the United States, we should—*e.g.*, in the latter part of 1879 and in 1880—have experienced what may be mildly called severe scarcity. But the method by which we have escaped this scourge has not been an unmixed benefit. To appreciate this consideration we need only look at what may be called the agricultural dilemma. The first condition of national prosperity—or I might rather say national existence—is abundant, and therefore cheap, food. But food may be too cheap for the interests of the producer. If his crops are ruined by increasing barrenness of soil, by unfavourable weather, or if prices are driven down below the remunerative point by foreign competition, the cheapness is to him no boon. The interests of the consumer and the producer can only be reconciled by enabling the latter to produce larger and better crops at a less outlay; this is the great object of M. Ville. Addressing

* On Artificial Manures, their Chemical Selection and Scientific Application to Agriculture. By M. Georges Ville. Translated and Edited by William Crookes, F.R.S. Second Edition. London: Longmans and Co.

more immediately a people who enjoy a better climate than do we,—that is, who can reckon with a nearer approach to certainty upon suitable weather for the maturing and ingathering of the harvest,—he naturally fixes his main attention upon appliances for increasing the productivity of the soil. He points out the curious and unwelcome fact that the progress of agriculture has not in France (and the same holds good in England) been at all proportionate to the increase and spread of manufactures. The manufacturer, indeed, enjoys certain advantages unknown to the farmer. If he sees fit to double his production he need only erect more powerful machinery and increase his number of hands, and he generally finds that by so doing his returns increase more rapidly than his outgoings. Not so the farmer: an increased quantity of labour often has no appreciable effect upon the returns at all. Improved manuring, as M. Ville advocates, will no doubt in the long run increase the amount of food to be extracted from the soil, but the uncertainty of the seasons forbids us to calculate upon this result as a matter of certainty for any given year. It has even been asserted that the rudest agriculture, where the seed is simply committed to a virgin soil, without manure and with little tillage, is the most remunerative where land is cheap and labour scarce, the returns, large or small, being almost entirely profit. This method of cultivation is of course quite out of the question in modern Europe.

But beyond the peril to the farmer of American competition, there lies a further and more serious danger to the entire community in England, France, Germany, &c. In what position shall we be when that competition ceases, if unable to produce our own food? Yet that time must assuredly come, and is every day drawing nearer. All the civilised portions of the earth are becoming more populous, and therefore require an increased amount of their produce for home consumption. At length the time comes when they begin to import food. The child just born may live to see the time when the United States will have nothing more to spare for Europe. This consideration should be stronger than all others in stimulating the nations to improvement in agriculture.

There are of course two very distinct directions in which minds of respectively different natures may look for the means of meeting the growing difficulty. Some, like the present writer, may fix their hopes on mechanical, physical, and chemical invention. Others, I fear the more numerous class in England, will seek relief for the farmer and plenty

for the community in the ways of political and social agitation. The attention of this second class may perhaps be usefully directed to a certain anomaly which weighs heavily both upon the farmer and upon the consumer of agricultural produce. It is this: the retail price of manufactured goods of all kinds is approximately regulated by the law of supply and demand; but as regards the natural produce of the earth, especially articles of food, this is not the case. Prices do not fall as the supply increases. A ring of middlemen have thrust themselves in between the consumer and the producer, and create artificial scarcities even by the destruction of perishable goods. Is this to be still tolerated?

Turning now from these introductory considerations we come to the main ideas of M. Ville's work. He maintains that four constituents only require to be supplied to arable lands in order to maintain, and even increase, their fertility, —that is to say, nitrogen, phosphoric acid, potash, and lime. He fully admits that plants require also other elements for their growth, such as hydrogen, oxygen, carbon, magnesia, iron, sulphur, &c. But he maintains that all these bodies are supplied in superabundance by the air, the water, and the soil, and their special presence in manures is therefore needless. The four more important principles he supplies in certain specified states. Thus nitrogen he gives by preference either as a salt of ammonium, generally the sulphate, or as a nitrate of potash or soda. In these states it is at once ready for assimilation by the plants, and is not liable to be lost by fermentation and evaporation. With nitrogen in organic compounds—*e.g.*, in wool-waste, hair, blood, fish-refuse, &c.—the action is not immediate. Decomposition must take place before nitrogen in such states is available as plant-food, and if such food is immediately needed time is lost. Further, during the decomposition of nitrogenous organic matters a considerable proportion of the nitrogen—according to M. Ville about 30 per cent—escapes in the free state, and is lost.

But whilst our author is at one with all other agricultural chemists in holding nitrogen essential for plant-growth, he differs from his colleagues by maintaining that leguminous plants, peas, beans, and lucerne, can absorb and assimilate the free nitrogen of the air. He finds that such crops are not appreciably benefitted by ammoniacal manures, and that generally speaking it is sufficient if one-half the nitrogen which is removed by crops is returned to it in the form of fertilisers. He asserts that a crop of lucerne yields per acre 264 lbs. of nitrogen over and above what can have been

furnished by the soil. The ammonia and the oxides of nitrogen present in rain-water are obviously insufficient to account for such a surplus. But, on the other hand, repeated attempts have been made to verify experimentally this supposed assimilation of free nitrogen by plants, and the result has been in every case negative. Some undetected source of error must therefore have been present, either in the experiments of M. Ville or in those of other chemists of eminence, many of whom investigated the question without any reference to his views.

Phosphoric acid M. Ville prescribes in the form of superphosphate; whether he considers that it is equally beneficial if combined with bases other than lime, such as potash or magnesia, it does not appear.

Potash he recommends in the forms of nitrate, sulphate, or potassium chloride, and here, as in the case of phosphoric acid, he insists on restoring to the soil, year by year, as much as has been removed by the crops. So far, therefore, he agrees substantially with the views of other chemists on the inorganic elements of plant-food. He differs from them in the importance which he ascribes to lime. In every one of his manurial formulæ, no matter for what plant it is intended or to what kind of soil it is to be applied, gypsum—sulphate of lime—is present. The gypsum which he thus prescribes is, further, in addition to that formed in the manufacture of the superphosphate, and which amounts to 110 for every 100 lbs. of pure tricalcic phosphate which has been used in the manufacture. It is also independent of the lime existing in the superphosphate in combination with phosphoric acid. M. Ville represents this unusual addition as having been proved itself in his experiments distinctly advantageous. But Messrs. Lawes and Gilbert in their experiments find gypsum a mere diluent. No one, of course, disputes that lime is for most plants an absolute essential, but in many soils it is present in quantities varying from 15 up to 90 per cent. Surely such a supply ought to be sufficient. If it be replied that the lime present in the soil exists in the state of carbonate, which is but very slightly soluble in pure water, it must not be forgotten that the water of rain and dew contains a supply of free carbonic acid, and is thus enabled to hold the carbonate of lime in solution. Besides many soils contain lime also in the state of sulphate. M. Ville, in maintaining that the other mineral constituents of the plants, including of course magnesia, may be dispensed with in artificial manures, asserts that even "the worst soils are superabundantly provided with them." If this is the case, either

magnesia is more abundantly present in the soil than lime, or the most important crops require it in a much less proportion. Neither, however, of these two suppositions is correct; even in soils derived from the decomposition of dolomite lime is found in a larger proportion than magnesia. And in not a few crops magnesia predominates over lime precisely in that part of the plant which is least likely to be returned to the soil. Thus in 1000 lbs. of the ashes of the grain of wheat, which in the ordinary course of things is sold, and ultimately finds its way into the sewers, there is found, according to Prof. Johnston, 120 lbs. of magnesia as against 28 of lime. But in the ash of the straw of wheat, which is very much more likely to be returned to the soil, there is only 39 lbs. of magnesia to 67 of lime. In the grain of barley, oats, rye, and maize, and also in beans and turnips, magnesia predominates. I do not therefore see how we can avoid the conclusion that the magnesia of arable lands must be more rapidly exhausted than the lime. General experience, in England at least, has certainly not confirmed the value of gypsum except for certain specific crops, such as clover, peas, beans, &c. Grain-crops have not received any appreciable benefit from its use.

The author fully recognises the low value of humus as a fertilising agent. Indeed, except as a means of rendering the soil more able to absorb and retain moisture, vapours, and gases, such as ammonia, and of supplying carbonic acid to effect the solution of carbonates of lime and magnesia and certain phosphates, few chemists will doubt M. Ville's opinion that it is without any direct utility.

I may perhaps here be allowed to refer to a point in which the experience of gardeners, nurserymen, and florists is at variance with the teachings of agricultural chemistry. The former lay much greater weight upon the physical condition and the texture of the soil than do the latter. Thus the florists' sheet-anchor is "loam." By this term he understands not the "loam" of the farmer, but simply the top spit of old pasture-lands, pared off and laid in a heap till the roots of the grass, &c., have rotted away. Now there needs no proof that the chemical composition of such "loam" must vary greatly, according to the geology of the district, the manures which may have been applied, &c. Yet I have never seen, in any treatise on floriculture, reference to these important distinctions. I cannot help thinking that if gardeners were to pay greater attention to the chemical requirements of their crops their results would be improved.

The main point in M. Ville's work is his most successful

attempt to show that chemical manures, if properly selected and applied, are more efficient and cheaper than farm-yard manure. This he proves by a perfect multitude of experiments made by different persons, in various parts of France, and upon soils of very different quality. Almost without exception a better and a more remunerative crop was obtained with the chemical manure. Farm-yard manure contains on an average 80 per cent of water, and, further, about 13 per cent of woody fibre and 4 per cent of silica, so that the really useful matter is included in the narrow limits of 3 per cent. Thus the farmer, in order to apply to his land 3 lbs. of matter which is needful, has to cart and spread 97 lbs. of what is valueless.

According to M. Ville there are in 1 ton of farm-yard manure, roughly speaking, 8¾ lbs. nitrogen, 2⅜ lbs. phosphoric acid, 8¾ lbs. potash, and 17½ lbs. of lime. If with most English agricultural authorities we affix no special value to lime, we shall have, say, 20 lbs. of really useful matter! This tiny speck of gold in a mountain of rubbish, so to speak, is, according to present prices, worth 10*s.* 6*d.* Consequently whenever farm-yard manure, stable manure, &c., cost more than this sum, including the expense of conveying to the field and spreading, their use involves a direct loss.

A further disadvantage of farm-yard manure is that its composition cannot be modified at will to suit the requirements of different crops or different soils. A larger or a smaller dose may be given, but the respective proportions of potash, of phosphates, and of nitrogen are not under control. With chemical manures the intelligent farmer can regulate these proportions to a nicety. If he finds that any particular field is sufficiently supplied, say, with phosphates, but is deficient in potash and nitrogen, he can give it a supply of the two latter without being compelled at the same time to add what is not needed.

This reminds me of a very common error to which Mr. Crookes adverts in a footnote. It is not uncommon to hear some such advice given to farmers as this:—"Do not buy chemical manures, but rather some good feeding stuff." This admonition is a survival of the old superstition (for no better name does it deserve), that matter by passing through the digestive system of an animal receives, in some occult way, an efficacy as plant-food which it did not possess before. It is all very true that by giving an animal more nutriment than it can assimilate, its excrements will have a higher manurial value. But there is a first loss in the animal; the whole of the nitrogen swallowed is not recovered in the form

of beef or mutton sold, *plus* the liquid and solid excrements of the animal. When the excrements are collected together and decompose, a second and more important loss takes place, some of the nitrogen escaping as ammonia and a further portion as free nitrogen, amounting, as I have already mentioned, to about 30 per cent. Unless, therefore, 100 lbs. of nitrogen in the form of oil-cake, &c., costs less than 70 lbs. in the state of nitrate of soda, sulphate of ammonia, or other nitrogenous manure, the notion of over-feeding cattle to improve their excreta as manure must be a financial mistake. Further, 1 ton of sulphate of ammonia contains as much nitrogen as 4 tons of good linseed cake.

M. Ville shows that there are cases when a crop which has suffered from a severe winter requires to be stimulated in the early spring. This is easily effected by means of a top-dressing of chemical manures, whilst farm-yard manure cannot be readily brought to bear, and even if applied its action is not immediately manifested.

It must not, however, be supposed that M. Ville seeks to proscribe farm-yard manure. Where it exists he recommends that it should be utilised, and if it is deficient in any essential principle, such as phosphate, potash, or nitrogen, it may be enriched by adding superphosphate, chloride of potassium, or sulphate of ammonia, as the case may require —a simpler, more expeditious, and a cheaper process than that of over-feeding live stock. Indeed the "feeding stuff" notion involves something very similar to a belief in the creation of power or of matter. One and the same particle of matter cannot do a double duty. If it is deposited on the limbs of an animal as meat, it cannot at the same time enter into and improve the manure heap. M. Ville's recommendations, then, are that all cattle should be fully fed ; that all land, arable or pasture, should be perfectly manured, but that no attempt ought to be made to increase the supply of farm-yard manure for this purpose.

It is a noticeable feature in the work before us that the author, though a chemist, does not recommend chemical analysis as a means of ascertaining what the soil of a field requires to fit it for some particular crop. He argues that, though analysis informs us what is the proportion of any given constituent in the soil, it does not show whether such constituent is in an available condition. If we extract the soil with an acid we dissolve out compounds from which, as they exist in the soil, the plant can derive no benefit. If we merely lixiviate with water we leave untouched matter which the plant, by means of the prolonged action of

carbonic acid, is able to assimilate. As an instance, on treating the soil of his experimental field at Vincennes with hydrochloric acid, the author found phosphoric acid in the proportion of 1581 lbs. per acre. On lixiviating with water the quantity obtained was only 25 lbs., but if beet-root is cultivated upon this land for three consecutive years it extracts from the soil 132 lbs. of phosphoric acid! Hence the author recommends, as a more practical and decisive method of learning the condition of the soil, the systematic formation and use of trial plots.

It is in these days something remarkable that M. Ville proposes no method of utilising the immense amount of plant-food which, in the form of human excreta, is daily finding its way into the rivers and the sea. He seems to consider the supply of nitrogen, of phosphates, and of potash practically unlimited. I cannot, however, help remarking that the problem of converting the free nitrogen of the air on commercial terms into ammonia, though possibly soluble, has not yet been solved. It is hardly safe to discount the results of a merely probable invention.

We have frequent references to irrigation as an anciently known means of fertilising the soil; but these passages deal merely with the flooding or inundation of water-meadows during the dead season of vegetation, and have nothing in common with the modern scheme of sewage irrigation applied continuously.

M. Ville, like many of his countrymen, is not a little exercised on a subject intimately linked with the national supply of food. France, more perhaps than any other country, has sought to keep down superfluous mouths; she has, so to speak, capitalised the funds which would have been required for bringing up a more numerous population, and she is now far from satisfied with the results. The fact remains that a Malthusian nation, or a Malthusian class in a nation, must simply efface itself unless similar principles were universally adopted. All schemes proposed by man to stamp out the struggle for existence in his own species seem doomed to failure.

Setting aside M. Ville's questionable views on the assimilation of free nitrogen and on the universal necessity for gypsum, his teachings must be regarded as of the highest value both in his own country and on this side the Channel.

V. WILL-O'-THE-WISP AGAIN.

By W. Mattieu Williams.

THE article on "Will-o'-the-Wisp" in last month's "Journal of Science" (p. 447) reminds me of my own experience, which, although by no means recent, is clearly impressed on my memory, and the impressions confirmed by reference to the diary which I very scrupulously kept in those days.

In the course of a walk from Genoa to Florence, long before there was any railway communication, I started on the morning of November 30th from Carrara, walked on through Massa to Pietra Santa. Here, as my diary states, I went on towards Lucca, and as it was late I enquired for an inn, and was told that I should find one on the roadside a mile distant. I walked on 4 or 5 miles farther, until it was quite dark, and found no inn or any other human habitation, the road being on a dead level with rice-fields covered with water on each side.

At last I saw what appeared to be the lights of a village in the distance, and after another half-hour's walking was surprised to find them still as distant as ever. I pushed on nevertheless, but got no nearer to the village. The idea of Will-o'-the-Wisp had not suggested itself; I merely regarded this as an instance of deceptive distance, until at last it became quite incomprehensible. Then I stopped and deliberately examined these lights, found that they were curiously flickering, and quite unlike the lights from house windows: further scrutiny showed that the idea of great distance was a delusion,—that they were faint, ghostly lights, at only a moderate distance, but which was very difficult to estimate. Then their true character suggested itself, and I turned round and found them behind me as well as in front. I walked on, and they preceded and followed me in a circle broken only by the road. I had already noticed this, which strengthened the first delusion, as they appeared like lights from houses on each side of the road.

Their brilliancy was less than is indicated by the descriptions I have read, less than that of the flame of a spirit-lamp at 20 yards distance. There was a multitude of them, all about 5 feet from the ground. I now suspect that the height

was that of my own eye, but did not think of this at the time, or might have made the experiment of stooping and putting my face to the ground, which experiment I now suggest to others who may have an opportunity of investigating the mystery.

None of the explanations quoted in the paper above referred to are at all satisfactory.

It appears to me that I was surrounded by a faintly luminous waving mist,—its luminosity so faint that it was only visible when a certain depth or thickness was presented in the line of vision; that at much greater depths than this the mist was opaque to such faint light, and therefore the luminosity presented itself as a ring with an inner radius corresponding to the depth necessary to render it visible by accumulation, and an outer radius limited by the opacity of the mist. The dancing fluctuation was probably due to the unequal diffusion of the luminous matter.

If this is correct its visibility only at and about eye-level (the lights appeared about a foot in perpendicular height) is explained, as on looking obliquely downwards there would not be a sufficient depth of the luminous matter between the eye and the ground, and on looking upwards the region of its diffusion would be penetrated,

I finally reached the town of Viareggio, and there learned that I had taken the wrong road after leaving Pietra Santa, and the next morning I walked back and then struck inland over the hills.

The absence of human habitations was fully explained. The road I had taken passed through a most pestiferous part of the Maremma, which is even more deadly than the Pontine Marshes, though of smaller extent.

If the modern theory, which attributes the poisonous action of the malaria to germs of *bacili* or *bacteria*, or similar microscopic organisms, be correct, this faint phosphorescence is easily accounted for. We have only to suppose these to be like so many of the lower forms of organic life which are phosphorescent. The ocean is so filled with these at times that the wake of a steam-packet is a belt of light of at least a hundred times greater luminosity than that which I saw over the Maremma.

It just occurs to me, in writing, that there may be some connection between these phenomena and the strange stories that are told of a luminous aura floating over death-beds, and which poetical people have attributed to the uprising of the departing soul. At the risk of being denounced as a materialistic brute I cannot help suggesting that this luminous

aura (if it really has appeared) was due to insufficient ventilation, permitting the stagnant accumulations of pestiferous emanations from the diseased body of the departing saint.

VI. EXPERIMENTATION IN BIOLOGY.

By Oswald Dawson.

> "Another field, as yet almost unworked, lies open to enquiry. . . . Organic Physiology has not afforded such assistance to Zoology as it might have done if it had been less exclusively forced into the service of practical medicine. An immense number of questions bearing the highest general scientific importance lie open to physiological enquiry in the vast number of different species of animals."—Karl Semper.
>
> "That introduces a new element into the question, . . . which leads us necessarily into very serious conceptions and questions of the nature of our whole being and moral responsibilities."—Henry Wentworth Acland.

THE above quotations sufficiently indicate the purpose of this Article: a multiplicity of circumstances combine to render prolonged delay in discussing the subject a matter for rebuke; certain of these may be enumerated,—viz., a short time ago an Association was formed for the advancement of *medicine* by research: in the event of this Association effecting the repeal of restriction biologists are free to investigate, thus availing themselves of liberty and publishing details at a time when defeat has rekindled the energies of the "anti" leagues. The latter will inevitably *then* distinguish between medical and biological vivisection. Consequently they will postpone further efforts to abolish or limit anew the former class, till the latter is suppressed; meanwhile medicine will be unconcerned to rescue its present ally, and biology will again be in the position it is today. This "Journal" alone has conspicuously recognised and insisted upon the claims of biological vivisection, and made exertions to secure those claims; but co-operation not forthcoming upon renewed invitation, it is abandoning its endeavours, save indirectly by aiding an association with a distinct ultimate object. Reflection will show this policy, being so readily capable of false interpretation, as hypocritical

concealment of real motive, to be ill-judged in the extreme, while the result of such coalition has been already traced above. Alliance is strength, but simulation of the ally is a tactic not enduringly strong. This policy being shown unwise, we must choose between reticence and the institution of a closer enquiry, for it is evident that what has been already said by this "Journal" has been insufficient to create sufficient agitation, while Dr. Acland's thrice-renewed effort to bring into prominence the distinction between medical and non-medical vivisection, before the Royal Commission, led to no further questioning on the subject, which accordingly fell into subsequent oblivion, the exertions of scientists and scientific journals being occupied in defending medicine, and the anti-vivisectionists admitting the matter "a little beyond" their comprehension: in that assertion there was more significance than appeared to them; the subject is a *little* beyond them, but not far beyond; the only visible indication of the remotest appreciation of the matter is to be found in the manifestation of a very peculiar feeling towards the English biologists, which, to take but one instance, so far enables the editor of the "Spectator" to overcome any compunctions in expressing the hope, on a vacancy occurring in a University chair, that Prof. E. Ray Lankester will be an unsuccessful candidate. But in deciding which course to adopt—reticence or renewal of the subject—a nobler motive must influence Science than the fear whether zoophily is likely to arouse soon: if it be that "another field, as yet almost unworked, lies open to enquiry," and that such enquiry is expedient, English biology must sketch its programme and remove the obstacles to the fulfilment of the task it has pronounced its duty. But we shall be led "into very serious conceptions and questions of the nature of our whole being and moral responsibilities," and the reader should remember we are here discussing the question of physical pain; he must bear in mind, too, how little can we form a conception of suffering except at the moment of endurance. These considerations apply to those also who are discussing medical vivisection in this and other journals at the present time, but their task is comparatively simple,—it is to weigh present infliction of pain with future alleviation of *the same*,—a mere question of transference in fact: no such translation is possible with us; pain is inflicted, but a "new element is introduced" in the benefit contemplated, such benefit, again, being infinitely more remote.

"Our ignorance of the laws of variation is profound." "The causes and conditions of variation have yet to be

thoroughly explored." These sentences epitomise an extensive portion of a literature supported from month to month by contributions from a heterogeneous assemblage of persons who discover their priority of mission to detect the oversight of Darwinism, whose negation of their interpretations of that system is presented to them in the very works they criticise, in the two passages cited above, to which others might be added. Favourably contrasting with the afore-mentioned is a distinct class of men who hold sufficient trial has not been accorded to factors in variation specified by other writers, and treated anew by, but consigned to subordinate positions in the system of, Mr. Charles Darwin.

One of these factors is known as "external conditions." Mr. Darwin devotes a chapter to the subject in the "Variation under Domestication," and a paragraph or so in the "Origin of Species." The subject commands a fuller respect in Mr. Herbert Spencer's system, while more recently special attention has been paid to the question, the various influences having been classified, and more or less copious examples cited under each section, in a volume of which we give the full title and a condensed account of such of the subject-matter as bears upon our question:—"The Natural Conditions of Existence as they affect Animal Life," by Karl Semper. The influences recognised are food, light, temperature, air, and water, still and in motion, living organisms, and miscellaneous. Prof. Semper discusses largely the influence of natural conditions, which it would be useless to recapitulate here; he likewise records many experiments as to the influence of artificial conditions; but these, it happens, are mostly of so trivial a nature that we may omit their consideration also. Several experiments refer to vertebrate animals, and thus are most intimately related to our enquiry: these are as follows:—The experiments of John Hunter and Dr. Holmgren on the transformations occurring in the coats of the stomach of birds, also mentioned by Mr. Darwin; the enclosure of Amphibia in masses of gypsum; the darker colouring of frog's skin following deficiency of food; the experiments of Pouchet on the chromatic function in fish, proving the conducting function of the sympathetic system of nerves—he severed the connection of certain of these with the spiral nerves, and produced a zebra-like marking on one side of the fish, the chromatophores of the side in relation to the uninjured nerves, which, being intact, conducted the optical stimulus as normally, retaining their natural hues as regulated by the

reflection from surrounding objects. In the section on the accommodation of water-breathers to breathing air, reference is made to the experiments of Jobert on the swimming-bladder of fishes, and, elsewhere, to those of Moreau and Jouriet. Some highly-valuable experiments by the author are detailed, entailing great inconvenience upon frogs, whereby it was established that a solution of 1 per cent of salt in the vessel of water tenanted by the animal was without any effect upon it: this was ascertained by observing that a frog so situated lived as long as one placed in fresh water; it was found that twice that percentage proved fatal in seven hours, and so on: by tying the animals to sticks in a special manner swallowing water was prevented, and of course the animals died of starvation in those cases where fatal osmotic action had not supervened. Claude Bernard and Paul Bert have made experiments in the same direction. But the main feature (for our present purpose) of Prof. Semper's volume is not the individual importance of the experiments given, these being comparatively insignificant from a zoophilist point of view, as the especial experimental character of the subject according to the views of the author; thus no less than (literally) a score of times does Prof. Semper lament the absence of experiment, suggest practical investigations on certain lines, complain about the prevailing fashions in modern zoology, the insufficiencies of our laboratories, and the forcing of Physiology too exclusively into the service of Medicine: he distinguishes a Physiology of *Organs* and a Physiology of *Organisms*, and thus (in part) anticipates Prof. St. George Mivart, to whom Biology owes gratitude for the most happy introduction of the term "Hexicology."

The announcement, a few years ago, as a "forthcoming" volume in the same series as the work of Prof. Karl Semper, by Paul Bert, on "Forms of Life and other Cosmical Conditions," warranted the anticipation of an original and masterly essay in this department, for M. Bert is well known to be experimentally acquainted with the Vertebrata from fish upwards, while he has not despised Invertebrates as low as Infusoria, but, judging by subsequent catalogues, this hope must be abandoned. But this circumstance and the fact that so few severe experiments are recorded in Prof. Semper's volume do not imply that little has been or may be done in the investigation of conditions and their influence. To renew the case of food, for example, Spallanzani accustomed a pigeon to meat, an eagle to a diet of bread. Voluntary change of diet occurs sometimes in Nature,

reindeer having eaten lemmings (Brehm), horses and oxen entered water to catch fish (Burdach), parrots taken to blood-sucking, and so on. Again, not only do morphological changes occur; thus the gastric juice of herbivorous animals is normally less active than that of carnivorous species, but by causing an herbivore to absorb peptogens the stomach may be rendered functionally carnivorous, experiment showing that peptones prepared by them, and injected into the stomach or blood of a carnivore, are assimilated, and not passed into the urine (see Letourneau; Biology, "Library of Contemporary Science"). The experiments of Réaumur, who introduced pieces of meat enclosed in perforated metal tubes into the gizzards of birds, and found they were dissolved,—and of Spallanzani, who performed artificial digestion by employing gastric juice from the living body,—upset the trituration theory of Borelli, Bœrhaave, and Pitcrairn, which had itself displaced the fermentation theory of Hilmon. By experiment we know that limitation of diet to one vegetable may kill a rabbit in about a fortnight; but as such condition of poverty has perhaps never occurred in Nature, the experiment loses its value for our purpose: this remark largely applies to the starvation experiments on the higher animals by Chossat, but those on Amphibia and snails are not without interest; thus a snail loses only one-eleventh part of its weight after a six weeks' fast, according to Burdach.

Prof. Semper devotes a chapter to "Other Conditions." The chief of these are pressure and electricity, but observations from Nature are alone recorded. Nevertheless the study of the effects of pressure is valuable in connection with the environment of fish; for instance, M. Cailletet erected apparatus in which fish were placed under a pressure of 400 atmospheres. The effects of electric shocks upon animals have been made known to us by Dr. Richardson's researches: ecchymosis, loss of hair, &c., may result, though it is doubtful, as Prof. Semper remarks, whether any other effect is produced in Nature by electricity save death, while here individuals, not species, are exterminated. Experiments have been made with regard to other influences, especially the action of poisoned atmospheres: the scientific value of these must be sought in the success attending any attempt to accustom an animal permanently to reside in a similar medium. Experiments on the effects of ozone have been chiefly interesting as showing the peculiar relative powers of endurance in various animals: thus mice live longer than rats, rabbits than guinea-pigs; but enough has

already been done to establish the truth that closely allied or distant species may be differently affected by the same influence, and the investigation now awaiting is the cause of each such difference. Anyone making a thorough investigation of the cave Amphibia, or other animals, might possibly be able to turn to account the experiments of Fubini on the relation of light and body-weight ("Journal of Anatomy and Physiology," October, 1875). In the light, frogs with eyes lost more than double in weight in proportion than blind ones, but in the dark both increased in weight, the blind ones less than their fellows.

"If Lamarck could have shown experimentally that even races of animals had been produced in this way, there might have been some ground for his speculations; but he could show nothing of the kind, and his hypothesis has pretty well dropped into oblivion, as it deserved to do." Such was the judgment pronounced by Prof. Huxley some years ago, and, though extracted from a lecture in the republication of which the author volunteers to accept no further responsibility than the accuracy of statements, the practical verdict is so rigidly in harmony with the spirit of the age, and so exquisitely adapted as a test for the further discussion of our question, that we needlessly delay in apologising for quoting it. Now it happened Lamarck advanced his views not as the thoughts of a precocious, fictitious reality,—"precocious" as too wise for his age, and a "fictitious reality" being, in truth, the *alter ego* of the author (De Maillet),—but in a "Philosophie Zoologique." Of this book Mr. Samuel Butler has recently presented English readers with a selection and translation of a copious number of passages bearing upon Evolution, and in various countries attempts are being made to establish the claims of Lamarck as an originator of a theory of Evolution worthy of considerable respect: thus we constantly hear of the "Lamarckio-Darwinian" hypothesis; France is naturally anxious to recognise all due merit; Prof. Cleland, in this country, detects much in modern theories to be Lamarck rendered anew, but unacknowledged. Additional proof is needless to show that the deserved oblivion of Lamarck is daily growing less manifest, yet no parade of quotations can fitly be substituted for an array of facts: new needs, no matter whether arising from variations in the environment or from any variation of disposition on the part of the animal, give rise to new efforts, and efforts to modifications. The power of emergency is well known; how ordinary speed can be quadrupled, leaps attempted without hurt, and tales (for several

see "Night Side of Nature") are on record of bedridden invalids, lingering life away, who have jumped up and been permanently cured at the cry of "fire." Necessity is the mother of invention in human affairs; what is it "the mother" of in animals? Animals would jump and endeavour to balance upon a shaking bough, if food were stored there, rather than hunger; birds would dive into a foot of water if clear enough to see grain at the bottom, food not being obtainable in other parts of the room; leaping from the ground to a bough is the first step towards leaping from one bough to another, and diving into one foot of water is a preparatory lesson to two, three, ten feet: by employing suitable apparatus for fixing to the animal, compulsory locomotion in water—the hind limbs being rendered incapable of action, with a view to reduction in the course of generations—might effect considerable modifications; the enforcement of the erect posture by quadrupeds, at the same time, entailing total disuse of the fore limbs, not by severing the nerve, might be impracticable; nevertheless appliances could be devised to render the lower primates habitually erect.

One experiment suggests another, and each other one several more, and the patience, time, and expense involved is surpassed only by the value of the possible result. Of course negative results would not repay the research, as maintained in the case of toxicological experiments.

A knowledge of the plasticity of living structures is of fundamental importance under the present aspect of Biology; though neglecting reference to natural phenomena or experimental verification, popular conception may ill appreciate its extent; realisation, however, is facilitated by an appeal to Surgery,—what seems more resistant than bone? Yet varicose veins leave their impress on the tibia; aortic aneurisms piece bone; articulations are formed anew; luxations obliterate the hollows made by tendons now removed from their normal situation; and so forth.

Ten years ago Dr. Ainslie Hollis wrote a series of papers on "Tissue Metabolism," to the "Journal of Anatomy and Physiology," the main discovery being that there prevails "a general correspondence throughout the animal kingdom in the sequence of phenomena observable after application of an irritant to living surfaces." Dr. Hollis's investigations in Vertebrate "Tissue Metabolism" related to such harmless parts as the "recently-abscised tail of a decapitated newt." His experiments on the higher Invertebrata were not satisfactory; the chitinous integument interfered

in the case of the Arachnida, while in slugs and snails the flow of mucous carries away the irritating matter. Several experiments were made on the earthworm, and eleven on a species of anemone (*Actinia mesembryanthemum*): of these one is of unusual interest; a piece of the animal was excised, and the edges of the wound inverted; some convoluted perivisceral tubes were upon the outer surface: after two days the wound was still unhealed, but upon the application of blistering fluid the wound was closed by the protrusion of a fresh supply of convoluted tubes; these, after a month's interval, underwent complete granular degeneration. How pregnant was John Hunter's phrase "stimulus of necessity"! Must we believe the pseudopodial moneron to be, with manual Man, the prince of inventors?

(To be continued.)

ANALYSES OF BOOKS.

A Treatise on the Distillation of Coal Tar and of Ammoniacal Liquor, and the Separation from them of Valuable Products. By GEORGE LUNGE, Ph.D., F.C.S., Professor of Technical Chemistry in the Federal Polytechnic School, Zurich. London: Van Voorst.

WITH the exception of a treatise published by the author, in the German language, as far back as 1867, and which is necessarily to a great extent out of date, the work before us is the first systematic and complete monograph on one of the most important branches of chemical manufactures.

The author possesses special qualifications and advantages for the task which he has undertaken. He is not merely an able and learned scientific chemist, but he has had most extensive practical acquaintance with chemical manufactures in general, and with this branch in particular. Thus he is, unlike some otherwise very eminent scientific men, fully competent to judge of the coal-tar industry from a commercial point of view. As a special preliminary for the compilation of this monograph he has not merely made a thorough study of the literature of the subject, but he has taken the opportunity to supplement his own experience by personal observations in a series of the largest and best tar- and ammonia-works in England, France, and Germany. He has also been aided by Mr. Watson Smith, formerly his assistant at the Zurich Polytechnicum, and now Professor of Chemical Technology at Owens College, Manchester, a chemist well versed in the treatment of coal-tar products, and by Dr. C. Meymott Tidy.

The resulting work must be pronounced in every way worthy of the high reputation of the author, and calculated to be of the greatest service to the chemical profession, as well as to all persons concerned in the management of tar- and ammonia-works.

One limitation must be noted in the outset. Dr. Lunge does not undertake—what, indeed, within the limits of a single volume would be utterly impossible—to discuss the manufacture of all the almost innumerable bodies known as coal-tar products. He treats merely of the compounds pre-existing in coal-tar, their separation and purification, not of their derivatives. Thus we find here instruction concerning benzol and anthracene, but nothing concerning the preparation of aniline from the former and of alizarine from the latter.

The first chapter of the work treats of the origin of coal-tar, with especial reference to the different quality of the products obtained from the destructive distillation of peat, brown coal, and the bituminous shales, of wood, and of true coal. All these tars are exceedingly complex mixtures, whose several constituents are far from having been thoroughly disentangled. A suggestion is thrown out here, at the very outset, that whereas up to the present day gas has been the main result of the destructive distillation of coal, and the tar a mere by-product, circumstances may possibly arise under which these relations would be reversed.

The author next gives a historical sketch of the applications of coal-tar and its products, from the earliest attempts in this direction made by Becker and Serle (1681), and Clayton (1737), dates, it will be remembered, anterior to the introduction of coal-gas as a lighting-agent. It was not, however, until 1856, the epoch of the introduction of aniline colours, that gas-tar ceased to be a burden and a nuisance. The production of benzol, the raw material for aniline, although amounting merely to 1 per cent of the gross weight of the tar, was for a time so remunerative that it became a commercial article in good demand. Unfortunately the producers of the raw material succeeded in establishing a system which places the tar-industry on an insecure footing. We refer to the contract-system, which renders it impossible for the distiller to buy what he requires from time to time in an open market.

A reaction soon took place in the value of benzol, when the discovery of artificial alizarine gave a fresh impulse to this industry. For the preparation of this important dye the raw material is anthracene, which is now, probably, the most valuable and remunerative of the constituents of coal-tar.

The present condition of the trade is thus summarised by Dr. Lunge :—" In England, where by far the largest quantity of gas-tar is produced, where benzene was discovered by Faraday, its industrial preparation by Mansfield, the first aniline colour by Perkin, and where the conditions are most favourable for the purchase of the necessary chemicals, as well as for the sale of the colouring-matters, the manufacture of artificial dyes has only risen to moderate dimensions. The same has taken place in France. On the other hand, in Germany and Switzerland, the manufacture of coal-tar colours has been established on an enormous scale, so that the tar produced there can only supply a small portion of the benzol and anthracene required, the larger portion being imported from England and France, partly in the form of aniline." This, we cannot help saying, is a state of affairs which surely demands very grave consideration. If we have lost a manufacture for which we have such decided natural advantages, what certainty have we of retaining others where our advantages are smaller ?

The quantity of coal-tar produced in all Europe is, according

to Dr. Weyl, 350,000 tons, of which the larger part is obtained in England, 50,000 tons in France, 15,000 in Belgium, and half that quantity in Holland. For Germany Dr. Weyl gives no figures, but, according to the "Chemische Industrie," the annual quantity there distilled is 37,500 tons. According to Mills, as far back as 1874 the weight of coal consumed in the United Kingdom, for the manufacture of gas, is 10,000,000 tons, which would represent a yearly production of about 450,000 tons of tar.

The production of tar at the gas-works fluctuates according to the quality of coal employed, and not less according to the temperature at which the retorts are worked. According to a table here inserted the yield ranges from 4 per cent of the coal up to 6, the quality also being far from uniform.

In connection with this subject our attention is drawn to the prospect of utilising the very large quantity both of tar and ammonia which at present are wasted in the conversion of coal into coke for metallurgical purposes. Attempts, it appears, have been made in this direction since 1768. Dr. Lunge, whilst noticing several of the processes proposed, does not commit himself to any statement as to their remunerative character. He considers, however, Dr. Angus Smith's report on the modified Knab process, as carried out at Bessâges, as rather too favourable.

A notice is also given of the proposal to obtain some of the most important constituents of coal-tar by decomposing the heavier oils (at present of little use) of the petroleum and paraffin oil-refineries. Here there is room to hope for results which may emancipate the tar-distiller and the dye-manufacturer from their present dependence upon the gas-companies.

In the second chapter Dr. Lunge treats of the properties of coal-tar and its constituents, of which he enumerates no fewer than 114, arranged under the heads of hydrocarbons, oxygenised compounds, sulphuretted compounds, and nitrogenised compounds. We find the remark that not a few authors of standing —such as Bolley, Wurtz, Girard and Delaire, &c.—have stated the specific gravity of coal-tar as being only equal to, or even below, that of water. In reality it ranges from 1·10 to 1·20.

The next chapter is devoted to the applications of coal-tar without distillation, such as for gas-making, for heating, for preserving stones, brickwork, metals, and wood, as an antiseptic (it has been used, in conjunction with lime and magnesium chloride, for the treatment of sewage), for the production of lamp-black and of printing inks.

In the fourth chapter we find an account of the first distillation of coal-tar, embracing dehydration, previous purification, the construction and setting of stills, condensing apparatus, filling and firing the stills, the principles and different systems of fractional distillation, with the separation of ammoniacal liquors,

light oils, carbolic, creosote, and anthracene oils, running off the pitch, and testing the tar.

The following chapters treat in succession of pitch, of anthracene oil, the sublimation of anthracene, and an account of its properties and analysis; of creosote oil, carbolic acid and naphthalene, light oil and first runnings, the rectification by steam and the final products, and ammoniacal liquor. Into these sections, which are written with thoroughness and care, want of space does not allow us to enter.

A very valuable feature of this work are the figures of plant and apparatus, which are very clear and carefully drawn, in most instances to scale.

The work must be pronounced a boon to chemical industry, similar in nature to the author's classical treatise on the manufacture of sulphuric acid and alkali.

The index is fairly copious and correct wherever we have tested it, and the getting up of the book is quite satisfactory.

Vignettes from Nature. By GRANT ALLEN. London: Chatto and Windus.

MR. ALLEN is deservedly well known as one of the happiest expounders of the great theory of Evolution. Few have done so much as he in winning for it the favourable attention of educated outsiders, especially among the artistic and literary world, and in lulling to sleep the watchful dragons of British Philistinism. At the same time, by his work, "The Colour Sense, its Origin and Development,"* he has rendered good service towards solving some of the most interesting problems which we encounter in the animal and vegetable kingdoms. The work before us, as the author tells us, "forms the record of a single summer's stray thoughts on Nature, from an easy-going, half-scientific, half-æsthetic standpoint." Here, as in all his writings, Mr. Allen shows himself as an orthodox Darwinian, not in the popular, but in the stricter sense of the term, to-wit, a believer in Evolution as effected by the processes of Natural and Sexual Selection. He claims for his essays nothing more than to be "popular expositions of current evolutionary thought," and hopes that "they may perhaps do a little good in spreading more widely a knowledge of those great biological and cosmical doctrines, which are now revolutionising the European mind," but which are being less rapidly assimilated by the national mind here in the native

* Journal of Science, 1879, p. 393.

country of Darwin than is the case in lands more remote. The author's modest anticipation is, we think, likely to be more than fulfilled.

The first of these essays, on "Fallow Deer," touches on two controverted points: Were fallow deer first introduced into Britain by its Roman invaders, or are they, as Mr. Allen inclines to think, a part of our indigenous fauna? Another disputed question is concerning the beech tree. The author refers to the time when England was clad by one almost unbroken sheet of oaks and beeches." Now Cæsar, in his Commentaries, notes the absence of the beech in that limited part of England which he overran. Archæologists have also remarked that whilst the ash and the oak have given names to a multitude of towns and villages in all parts of the Island, very few truly pristine names can be traced to the beech, Buckingham being one of the few exceptions.

Reference is made to the wild cattle of Chillingham as an interesting survival of our old mammalian fauna; but here, as in other writings on the same subject, it is overlooked that a herd of the same species exists at Lyme Park, near Macclesfield. The sketch of the development of horns in the ruminant animals is beautifully clear and simple. With one passage, however, we must venture to disagree. The author pronounces horns "weapons of rivalry, all but useless against other species." Now, any one who has ever seen, *e.g.*, a bull or a buffalo fighting, whether against human, canine, or feline foes, will hesitate at endorsing this view. With a speed little to be expected from so ponderous an animal, he strikes right and left with his horns through a breadth of nearly four yards, rushing rapidly forwards all the time. The "horn of hart" was, in the days of our forefathers, dreaded alike by huntsman and hound. Two flaws somewhat mar this otherwise pleasing and instructive essay: The author goes out of his way to announce his political creed, and he twice makes use of the cant expression "dumb," as applied to the lower animals.

The essay on "Sedge and Woodrush," calls attention to a circumstance often overlooked by beginners in the study of Natural History, and especially by those unreasonable beings who, without being or seeking to become naturalists at all, insist upon criticising Darwin and his coadjutors. Says Mr. Allen:—"Contrary to the general belief, Evolution does not by any means always or necessarily result in progress or improvement. Nay, the real fact is that by far the greater number of plants and animals are degraded types,—products of retrogression rather than of upward development." By dint of overlooking this truth, first, we believe, worked out by Prof. E. Ray Lankester and Dr. Dohrn, of the Naples Aquarium, Prof. Minot was led to the conclusion that man is not the highest mammalian type.

The chapter entitled the "Hedgehog's Hole," gives an interesting survey of the position, past and present, of the Insectivora.

Here, also, some questions are answered with which the tyro is often perplexed.

In a pleasant sketch of Musbury Castle, redolent of the fresh air and the blossoms of a fine May morning, Mr. Allen calls attention to the local constancy to be noted in the distribution of the fauna and the flora. We are far yet from having mapped out the ranges and occurrence of species, even in this limited and, to the naturalist, poor country of ours. As for the how and the wherefore, they are scarcely yet touched upon. Whilst treating of the Guelder Rose, and proclaiming his dislike of the double flowers of our gardeners, the author reminds us that "the labour of the old-fashioned naturalists has collected an enormous mass of facts as to form and structure; but as to use and function, we have still almost all the work to do." How sad, therefore, that this particular department of biology is so much interfered with and threatened by the hostility of modern sentimentalists.

In the "Heron's Haunt," the author develops his theory that the chromatic tastes of birds seems to get quickened in their daily search for food among the blossoms and fruits of southern woodlands." He seems, however, to place the birds of paradise too exclusively among fruit eaters. Though partially frugivorous, they are like their kinsfolk, the crows and jays, exceedingly fond of insect larvæ,—a class of beings not generally remarkable for brilliant colouration, and often found amidst dull sombre-hued materials.

In a "Bed of Nettles," Mr. Allen gives, in his adherence to the tradition, that nothing soothes a nettle-sting like dock-leaf, to which he, however, adds "philosophy." We have often been nettle-stung whilst poking about after insects in the hedges and ditches, and have from time to time tried the dock-leaf as a remedy; but we never felt any decided benefit, and to this day we are unable to say whether the pain abates more rapidly if the wound is rubbed with dock-leaf or if it is let alone. But there is a great amount of idiosyncrasy as regards this same sting. We know persons who, if "nettled," feel the irritation the next day.

Under the title of the "Carp-Pond," the author traces the wanderings and distribution of the Cyprinoids from their original home in Central Asia. He remarks that we have no Siluroids in England, as our streams are too pure and clear and rapid for them. Surely the purity of our streams is more a matter of tradition than of modern observation, and on the eastern side of England the rivers have never been characterised by rapidity. Their distribution he justly characterises as utterly unintelligible save on evolutionist principles.

Contemplating a Llyn Gwernant trout, a peculiar and strictly local species, found only in one small mountain tarn in Wales, the author makes the strange remark: "I have certain compunctions of my own about the morality of catching a trout for such a purpose," *i.e.*, in order to watch and report upon its

specific peculiarities! Our Bestiarian friends, "if they will permit us to call them so," may perhaps be misled by this passage into thinking that they have here found for once a man of sense to sympathise with them. But let them read on, and they will be dismayed. "After all," says Mr. Allen, "it is just as legitimate, I suppose, to catch a fish in the interests of science, as to catch it for the sake of dishing it up at supper in a tempting brown case of egg and bread-crumbs." The account which our author gives of the development of this species is substantially conceived in the spirit of Herr Wagner's theory of segregation. A few trout found their way into the tarn; gradually, as the brook went on carving its way through the rock, access was rendered more difficult. "So, after a while, no more trout could re-inforce the small colony in the tarn, which would thus have room to develop in their own way to suit their own peculiar circumstances, without any cross of fresh blood from the old stock to keep them true to the general type of the race in the lowland rivers." He goes on to say that in such isolated localities, enemies, if any, are fewer in number. In other words, the struggle for existence is less severe, whilst spontaneous variation is more likely to occur from change of food and other external conditions. Whilst recognising this sketch of the probable origin of the Llyn Gwernant trout as having the strongest probability in its favour, we feel an additional interest in noting the close approximation to Herr Wagner's views here made by so decided a Darwinian as Mr. Allen.

We must here, however, close our survey of this pleasing and instructive little book. Not only does it record observations,—it will make observers.

The Life of Charles Darwin, with British Opinion on Evolution. Compiled by G. W. Bacon, F.R.G.S. London: G. W. Bacon and Co.

In analysing this biography of our great naturalist we cannot help noticing that the hostility against him and his teachings, which had of late years greatly subsided, has to some extent been rekindled. M. Moigno has characterised the faint praise of M. de Quatrefages as savouring too much of academical courtesy. Nearer home a writer has sprung up, who, though palpably new to the study of biological science, boldly ventures to lay down the law on this its most complicated and difficult question. It is too much to hope that the case should be otherwise. In England the public is apt to listen with respect to opinions confidently expressed, to arguments and objections

difficult to meet because totally beside the question, without insisting that the author should have given the subject any prolonged and careful attention.

The little work before us gives a fair, though brief, biography of Darwin, in as far as it can be furnished from sources generally open to the public. Of his descent from Erasmus Darwin, and of the generally intellectual character of the family, the public is already well aware. But it is interesting to learn that Robert, the father of Erasmus, had some scientific and poetical tastes, and that his wife was a very learned lady. Her husband does not seem to have admired her classical attainments, for he composed a kind of Litany, one verse of which runs—

> "From a morning that doth shine,
> From a boy that drinketh wine,
> From a wife that talketh Latine,
> Good Lord deliver me."

The Darwin race seems to be an admirable instance of heredity. They have almost invariably lived to a good age. For at least four generations the family has been far above the average run of civilised mankind in intellect, and in two instances it has reached the height of that rare attribute, genius. They have repeatedly intermarried with other families of an unusual mental calibre,—a fact which will be at once recognised on noting that both the mother and the wife of the illustrious Evolutionist were descendants of Josiah Wedgwood. Another point to be noticed is their persistence in selecting professional careers. For 260 years, when not country gentlemen, they have been physicians, less generally lawyers, or soldiers. We do not learn that any member of the family has been engaged in trade, nor have they aimed at a parliamentary career or at official position of any kind. They have been men of thought rather than of action, in the ordinary sense of the word.

The life of him whom we call the great Darwin was singularly quiet, and characterised by a philosophic simplicity rare in this age of turmoil, bustle, and ostentation. After his memorable voyage he rarely left his home, and lived mainly in his works. Though a member of several of the principal scientific societies of London, and warmly interested in their welfare, he rarely attended their meetings, save to communicate some of his results, and here, as in all his doings, he showed a most remarkable modesty and an "evident unconsciousness of his own greatness." Self, indeed, with him, was completely merged in his devotion to his subject. He never delivered a public lecture, never filled the presidential chair of the British Association, or of any of its sections. Most singular, he took no part in the great Darwinian controversy, which began in 1859 with the appearance of his great work the "Origin of Species." To all reasonable, candid doubters and dissidents he was ready to reply in an exemplary

spirit of patience. Those who assailed him with abuse he left to be dealt with by the numerous and able disciples who—alike in this country, in Germany, and in America—were gathering round him.

The second portion of the little work before us, "British Opinion on Evolution," consists of tributes to the greatness of Darwin paid by men and by journals of the most varied parties and sects, yet all uniting in their appreciation of his genius and of his work. Whether the writers of these official eulogiums worshipped the Darwin of reality, or some picture of him limned more or less according to their own notions of what he should have been, the future must show. The time has not yet come for us to understand all his greatness.

Mr. Bacon's "Life of Darwin" ought to be found in every school-library, and in the home of every thoughtful working man.

A Dictionary of Popular Names of the Plants which furnish the Natural and Acquired Wants of Man in all Matters of Domestic and General Economy, their History, Products, and Uses. By JOHN SMITH, A.L.S. London: Macmillan and Co.

WE have here a useful work, in a department of English scientific literature not over-crowded, and compiled by an author who has enjoyed exceptional opportunities for his task. Mr. Smith has for upwards of forty years been officially connected with the Royal Botanical Gardens at Kew, and was the Assistant to the late Sir W. Hooker in establishing and arranging the Kew Museum of Economic Botany. The plants are arranged alphabetically under their English names, in as far as such exist; the botanical names, according to Dr. Lindley's system, being used for the purposes of reference and identification. It is not too much to say that the work teems with valuable and interesting information, much of which is quite unknown to the reading public. It is sad to learn that many of the Australian species of *Acacia* are in danger of extirpation. They are cut down in quantity for the sake of their astringent bark, and no steps are taken for their propagation.

Concerning the Almond the author states that "none now come, as formerly, from the Valley of the Jordan." We have heard it lately maintained, however, that the name Jordan almonds is simply a corruption for Jardin,—*i.e.*, cultivated almonds,—and that they never were imported from the Valley of the Jordan.

The apple tree of the English version of the Old Testament is considered, on the authority of Canon Tristram, to be the apricot, which is exceedingly common in Palestine.

Hibiscus Rosa-sinensis possesses a singular property. Its red flowers when bruised turn black, and are then used for "colouring the eye-brows and blacking shoes." It is possible that this plant, which flourishes in Australia as well as in its native China, might be of service in dyeing.

A similar remark might be made concerning the red juice of the blood-berry (*Rivina humilis*), which is used in South Carolina as rouge, and the red juice of *Baloghia lucida* (the Norfolk Island "bloodwood").

Brier-root pipes, it appears, are made not from the root of the brier, but of the *bruyère*, a small tree of the heath family (*Erica arborea*), growing in Southern Europe and in Algeria.

We differ from the author in his statement that the Chinese green dye Lo-kao is extensively imported into this country and France. It was at one time met with in commerce, but is now superseded by the aniline greens.

We find Mr. White classes camwood and barwood as identical. The products met with under these names in the market show a decided difference when applied to tinctorial purposes, the colouring matter of camwood being the more soluble of the two.

Chica, sometimes used as a red dye, is, we learn, a monopoly in the hands of certain missionaries.

Concerning the cow-tree of Venezuela a curious incident is recorded. In 1830 a speculator introduced a thousand young trees into this country, and offered them for sale, quite forgetting that a tree from Venezuela could only flourish here in a hothouse! It further turned out that his cow-trees were not the genuine species described by Humboldt, but a species of *Achras*.

Concerning cudbear and orchil we cannot agree with Mr. White. Cudbear is now, and has for a long time been, obtained from the "orchella," the process of manufacture being different.

Saffron the author speaks of as a "valuable dye." This is no longer the case, as we have a perfect plethora of yellow dyes, many of them far superior to saffron in beauty and permanence.

This work will prove of no small value to all who take an interest in the vegetable kingdom, and who wish to know the original sources and the uses of our cultivated plants. It is least to be depended upon in the tinctorial department of technology.

The Field Naturalist and Scientific Student. No. 2, July, 1882. Manchester: A. Heywood and Son.

This new journal began well, and is going on better. In the present issue we notice some very interesting facts on the habits of animals. Mr. W. J. V. Vandenbergh gives a case of a "tame rabbit devouring earth-worms with evident relish." This, after all, is the less surprising if we reflect that other rodents—such as the rat, the mouse, and the squirrel—not only accept animal food, but attack and devour such creatures as they can master. Parrots, also, it appears in another paragraph, are liable to become carnivorous. Not to speak of the kea (*Nestor notabilis*) of New Zealand, but according to Dr. Buller "a whole fraternity of caged parrots took to cannibalism, killing and devouring each other, a *Platycercus semitorquatus* taking the initiative." There were four species, and, what is the more remarkable, the birds had lived in peace together for nearly two years. It thus appears that there is no such distinct boundary between carnivorous and frugivorous animals as closet naturalists, especially those of the Old School, would make out. There are, we may say, *carnivora de jure* and *carnivora de facto*, the former doubtless especially qualified for an animal diet, but the latter being easily led, by very trifling changes in their conditions of life, to turn predatory. It must also be remembered that many creatures which are carnivorous in their adult state become vegetarians when mature, whilst others—such as the robber-fly (*Erax apicalis*), so justly detested by bee-masters in some parts of America—reverse the process.

The Rev. M. G. Watkins raises the question "Do fishes feel pain?" It is said that "a large trout, taken in Loch Awe with an artificial minnow, had no fewer than five other minnow tackles, all bristling with hooks, hanging round its mouth." This is a subject by no means cleared up. Some close observers maintain that, as in fishes, the mouth is the principal organ of touch, we can scarcely conceive of it as insensible.

Some strange instances of mimetic resemblances and mimicry in animals are given by Mr. J. E. Peal, partly from the "Scientific Roll." It is said—"The tiger imitates the whistle of the large Sambur deer (to call it) so closely that only a trained ear can tell the difference. The leopard also imitates the smaller deer. The crocodile's eye and nose, floating on our muddy waters, exactly resemble the lumps of dirty foam so common here."

The "Field Naturalist" is doing a useful work, and has our good wishes.

*Le Monde Animal.** Par Madame STANISLAS MEUNIER. Paris: Hachette et Cie.

THIS work belongs to a series which is appearing under the title "Bibliothèque des Ecoles et des Familles." It consists of a series of sketches of some of the most remarkable animals, or of those which in the character of friends or of enemies intervene most closely in human interests. As a preliminary, we find a short section on classification, thoroughly Cuvierian, and therefore thoroughly out of date.

The animal kingdom is divided into four great groups, the mollusca being made to rank second, and all the remaining invertebrates, except the articulata, being summed up as zoophytes. The authoress, however, admits the necessity of adding a fifth class for the protozoa. For the apes in general, the name quadrumana is retained, little consideration being given to the anomaly of ascribing the name "hand" to an extremity provided with a true heelbone.

In her description of the elephant, the authoress makes the strange remark that the Hindoos and English still utilise these animals "in this barbarous manner," *i.e.*, in battle. Here she is mistaken: elephants are doubtless employed in our Eastern army in transporting artillery, but they are never caused to take part in action.

In describing the horse, she writes: "The Arab horse, the English horse, like the heavy Norman horse, the ass, the hippopotamus, and the swine belong to the order of ordinary pachyderms." We do not see the advantage of keeping up this arrangement. They might better have been grouped together as the odd-toed animals.

The description of domestic poultry is embellished with an engraving of a cock-fight. Though nothing is said in the text concerning the nationality of the scene, yet the costumes of the spectators too plainly proclaim them as Englishmen. Alas, we cannot accuse Madame Meunier of having slandered us; ultra-humanitarian, or rather bestiarian England, which objects to the infliction of pain and death in the cause of science, is now experiencing a revival of cock-fighting, and very tenderly does she deal with the offenders!

The description of the carrier pigeon and its exploits leads the authoress not unnaturally to an account of certain painful episodes of the siege of Paris.

The chapter on venomous serpents is not free from marks of exaggeration. Thus it can scarcely be admitted that the existence of powerful antidotes against their venom is demonstrated.

The character of the toad is effectively vindicated from the superstitious accusations brought against him in France as well

* The Animal World.

as in England. It is well to teach youth that this persecuted creature is not merely innocent but positively useful to man.

The cockchaffer receives a considerable share of notice, as being in France much more numerous, and consequently more destructive than in our colder climate. As a means of turning them to account, it has been proposed in Germany to eat them! We fear our appetite and our courage would fail us in the experiment. A curious instance of their tenacity of life is given on the authority of Pouchet. A number of them having been submerged in water for forty-eight hours, and having to some extent entered into decomposition, if we may judge from the offensive smell and the discolouration of the water, revived on being taken out and exposed to a temperature of 77° F., and the next day four-fifths of them flew away.

The modern scourge of France, the phylloxera, is described at length. The authoress appears to have but little faith in the various schemes devised for combatting this frightful pest.

Notwithstanding a few questionable statements and the somewhat archaic classification which here and there comes to the surface, Madame Meunier's work is well suited to the readers for whom it is intended.

Studies of Venus Transits. An Investigation of the Circumstances of the Transits of Venus in 1874 and 1882, originally forming part of "The Universe and coming Transits." By RICHARD A. PROCTOR. London: Longmans and Co.

TRANSITS of Venus, as the general public has been to some extent aware since Captain James Cook's first voyage, are of great scientific importance, as furnishing astronomers with one of the chief means of ascertaining that capital point, the distance of our earth from the sun. Such opportunities are rare, and when they occur are, or should be, eagerly and intelligently utilised. The present generation is in this respect eminently favoured. A transit took place on December 8th, 1874, and on December 6th next another will occur, which will be carefully studied by parties of qualified observers sent out by different governments to the most favourable stations. After this year no other transit of Venus will occur until the year 2004, a date naturally beyond the personal concern of any person now living.

The treatise before us is a portion of a larger work entitled "The Universe and the coming Transit." Some parts of the subject-matter had previously appeared in the "Journal of Science," the "Spectator," and especially in the "Monthly Notices of the Astronomical Society."

Concerning the relative value of the two transits of 1874 and 1882, Mr. Proctor differs from certain of his brother-astronomers, including the Astronomer Royal, Sir G. Airey, in attaching greater value to the earlier of these two transits. In certain portions of his work, which have now a mere historical interest, he argues that the preparations made by England for observing the former transit are not so complete and satisfactory as the occasion demanded. He gives in one chapter certain corrections of the Astronomer Royal's statements, and shows that in recommending certain localities for observation "someone had blundered." The localities recommended as stations for the phenomenon of 1882 would have been exceedingly suitable for that of 1874.

Microscopical Section Cutting. A Practical Guide to the Preparation and Mounting of Sections for the Microscope. By SYLVESTER MARSH, Licentiate of the Royal College of Physicians of Edinburgh, &c. Second Edition, pp. 156. Seventeen Illustrations.

THE first edition of this work, published in 1878,* has been for some time out of print, and has enjoyed the honour—thanks to the absence of international copyright arrangements—of a piratical issue in America. The present edition has been much enlarged and many new processes added, keeping pace with the numerous discoveries during the past few years, and including the new freezing microtomes working with ether spray instead of ice. Where tissues only require to be cut occasionally, or ice is difficult to procure, these machines are invaluable.

Very full details are given as to the various modes of staining tissues, processes which have done so much to advance histological investigation. Many new formulæ appear in this edition, and minute instructions are given for carrying out the operations on tissues requiring special treatment.

Every worker with the microscope knows that very few objects are in a condition for examination just as they are, except in the case of very thin and very transparent bodies; the only means of learning anything about their internal structure must depend upon the power of cutting sections of a suitable thickness. In most cases this needs a certain amount of preparation, varying with nearly every substance, to render cutting practicable: many tissues, also, after sections are made, are apparently homogeneous, and need the application of various colouring reagents to differentiate their otherwise invisible structure. It is true that

* Journal of Science, vol. i. (3rd series), 1879, p. 135.

beautifully cut and stained sections of both animal and vegetable tissues are now to be purchased, but the student requires something more than these,—he must have the power of investigating for himself,—and in Dr. Marsh's little book he will find a trustworthy guide to one of the most difficult branches of histological manipulation.

Household Chemistry for the Non-Chemical. By ALFRED J. SHILTON, F.C.S., Lecturer at the Midland Institute, Birmingham, and at the Walsall Institute. London: F. V. White and Co.

WE have here a work which seeks to explain some of the chemical phenomena daily witnessed around us, and to extract from them certain useful lessons. Books of a similar tendency, as the author admits, have from time to time been written,—we need mention only "Liebig's Letters," and an equally well-known treatise, the "Chemistry of Daily Life," by the late Prof. Johnston. In Mr. Shilton's judgment such works, however, have been at fault in containing "a quantity of matter that is certainly not of a strictly chemical nature, and which, however interesting in itself, swells the book to a large size without adding to its usefulness." It might perhaps be contended, in comment upon this passage, that it is a somewhat exceptional case when "interesting matter" does not add something to the usefulness of a book. What is more important, it is a difficult task, in treating of such subjects as our author undertakes to discuss, to eliminate all matter which is not of a strictly chemical nature. Mechanical, physical, biological, geological, and meteorological considerations obtrude themselves. Thus much of the process of candle-making, as described on pp. 39 to 41, is purely mechanical. Again, the last chapter, on food and physiological chemistry, includes no little matter which is strictly biological. In fact, were we to go over the entire book and strike out every passage not exactly chemical, not merely would its bulk be considerably reduced, but the connection would often be destroyed. We have pleasure, however, in admitting that most, if not all, of the subjects introduced are accurately and clearly, sometimes happily, treated, and that not a few popular delusions are shown forth in their true light. With one passage we find ourselves unable to agree: the author, speaking of bleaching agents, says —"The most important of these are chlorine, chloride of lime, and sulphurous anhydride. They all act by their power of oxidation, converting the colouring-matter into constituents which are more or less colourless."

That old rags can be transformed into starch-sugar by the process described by the author is perfectly true, but we devoutly trust that this transformation is not carried on anywhere upon a manufacturing scale. Old rags may be, and often are, saturated with the infectious matter of various diseases, and it by no means follows that such matter would be completely destroyed by the process of transformation.

Among the errors which the author exposes is the popular faith in "egg-powders." These, he points out, have nothing in common with eggs, being merely baking-powders coloured with turmeric. They may consequently colour and lighten, but cannot enrich the cakes, &c., to which they are added. The "corn-flours," he reminds the public, are simply starch, and as such contribute nothing to the formation of blood. It is something curious that an enlightened British public turns up its respectable nose at Indian meal. But if anyone extracts from such meal all its more valuable constituents, the albumenoids, the saccharine, and the fatty matter, and offers the refuse, or starch, at a high price, the public aforesaid buys and eats.

Ozone is another popular delusion. We can fancy the horror and disgust of Paterfamilias when he reads that the odour which he so greedily inhales at the sea-side consists "principally of the effluvium from decomposing crabs and sea-weed." The facts are that the presence of ozone in the atmosphere is far from proven, and that its physiological action is by no means invariably salutary.

"Household Chemistry" may be pronounced useful reading for young and old.

The Student's Guide to Quantitative Analysis, intended as an Aid to the Study of Fresenius's System. By H. Carrington Bolton, Ph.D., Professor of Chemistry in Trinity College, Hartford. New York: Wiley and Sons. London: Trübner and Co.

This work contains instructions for the quantitative examination of a number of selected bodies ranging from barium chloride up to urine, raw sugar, and petroleum. It must be remembered, as accounting for what the author calls the fragmentary character of the instructions, that they were originally intended as lecture notes, intended more to remind the student of the main features of the methods to be followed than to give every routine detail of procedure. Under each head there are also references to special authorities.

Turning to the instructions given for the analysis of potable

waters, we find that the author recommends determination of potassium, sodium, magnesium, calcium, chlorine, sulphuric and silicic acids, organic and volatile matter, total solids, hardness, and oxygen required for the oxidation of organic matter. We do not find any reference to the possible presence of phosphates, nitrates and nitrites, ammonia, and nitrogen in organic combination—omissions to be regretted, since these substances, if found, are the chief indications of animal pollution, and serve as a pabulum for any germs of microbia which may be incidentally introduced. Nor are there any hints as to the possible occurrence and determination, if needful, of certain heavy metals, such as lead and copper.

In the analysis of milk Dr. Bolton recommends the determination of water (adding washed and ignited quartz-sand for the desiccation-process), fatty matter, sugar, total solids, and proteine compounds, the last item being found as difference.

Under Petroleum we note a circumstance with which we have been often struck in American technological and chemical treatises,—the preference given to Baumé's hydrometer. We are not aware that this instrument possesses any special or peculiar advantage, whilst it is open to the serious objection that its degrees cannot be converted into direct specific gravity by a simple calculation.

A Treatise on the Theory of Determinants, with Graduated Sets of Exercises for Use in Colleges and Schools. By THOMAS MUIR, M.A., F.R.S.E. London: Macmillan and Co.

THE object of the author of this work has been to furnish a full exposition of the theory of Determinants in a form suitable for students. The book is divided into four chapters, the first of which is merely of an introductory nature. The second chapter, devoted to determinants in general, furnishes their definition and all their important properties. The third chapter treats of special forms of determinants, such as continuants, alternants, symmetric determinants, skew determinants and Pfaffians, compound determinants, &c.; whilst the fourth chapter gives the history and bibliography of the subject from the Leibnitz downwards. An Appendix gives the results of the Exercises.

Papers and Proceedings and Report of the Royal Society of Tasmania for 1880. Hobart Town: Mercury Office.

We find here not a few facts of interest placed on record. Thus there are given the times of leafing, flowering, and fruiting of a few plants, as observed in the Tasmanian Botanical Gardens, from January to September inclusive. Black mulberries ripen in January, and peaches in February. The leaves of the ash and the oak begin to fall at the end of March. *Pyrus Japonica* flowers in June, and the yellow crocus in July; the apricot, poplar, and elm flower about the end of August, and the horse-chestnut in September.

Mr. F. McCoy and Mr. C. Gould notice the existence of large animals, probably seals, in the upland lakes of Tasmania, and suggest that the mysterious "bunyip" of the Australian natives is merely a seal of the group having external ears.

A paper entitled "Introductory Notes to the Natural History of Tasmania," by the Rev. J. E. Tenison-Woods, F.L.S., &c., is mentioned as having been read, but unfortunately is not inserted.

Mr. F. M. Bailey contributes an elaborate paper on the "Lichens of Queensland," in which their tinctorial properties are not overlooked.

The Rev. J. E. Tenison-Woods read a paper on "Some Introduced Plants of Australia and Tasmania." It is curious to learn that the common sweet-brier has become a rampant and formidable weed; so have the cochineal cactus, and one, or perhaps two, of its kindred. The common European furze is very abundant in Tasmania, but is not found on the Australian mainland. The American butterfly *Danais erippus* occurs all over Australia, and has been seen far out at sea in immense flights. It will probably become almost cosmopolitan.

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures, and Condition of the Institution for the year 1880. Washington: Government Printing-Office.

This volume, in addition to the usual formal matter, contains a very copious and elaborate synopsis of the scientific writings of Sir W. Herschel.

There is also what may be called a directory of astronomical observations. It was the wish of the Council of the Smithsonian

Institution to obtain particulars concerning the staff, the instruments employed, and the character of the observations made. For this purpose circulars were sent round to all known establishments in America, and to many abroad, but in not a few instances the replies are very imperfect.

There is an interesting account of an official visit by the officers of the Smithsonian Institution to the Luray Cavern, in Page County, Virginia, a cave in a compact bluish Silurian limestone, probably not more ancient than the Mammoth Cave and the Wyandotte. The opinion of the visitors is that there is no cave in the world more profusely decorated with stalactites and stalagmites than that at Luray. There are no pools or streams, and consequently no aquatic fauna. A few spiders, flies, and one myriapod have been found.

The report on the progress of anthropology is exceedingly valuable. The reporter remarks that comparative psychology "has its bitter controversial side. Between the atheistic materialists, the agnostic materialists, and the theistic dualists there still exists that personal prejudice which blinds the eyes of the observer and confounds right thinking."

The volume also contains reports on the progress of astronomy, geology, physics, chemistry, botany, and zoology.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

THE "IMPROVEMENTS" IN EPPING FOREST.

To the Editor of the Journal of Science.

SIR,—There is every reason to fear that the process of converting Epping Forest into a park, which you have so justly deprecated, is being quietly pushed on, and that it has already begun to tell upon the fauna of the district. On the 12th instant I went along with an entomological friend to the Forest, and, though the day was most propitious, we were struck with the total absence of not a few kinds of butterflies which used to frequent the lower, or Chingford, end. I cannot help suspecting that the disappearance of the woodland pools, which have been drained to form the artificial lake, has something to do with the matter. I do not, for my part, see the necessity for this lake, especially as the River Lea offers full facilities for boating, bathing, and drowning. I found, also, that several old gravel-pits at the Epping end of the Forest, which I have known as the special resort of various insects, have been filled up and made level with the surrounding ground. If this process is to continue, the sooner naturalists know that the Forest is no place for them the better.—I am, &c.,

E. C.

THE EFFECTS OF BLUE GLASS.

To the Editor of the Journal of Science.

SIR,—Happening to take a rather prolonged look-out through a blue glass window which commands a view of sundry suburban gardens, I found the colour of the objects changed in a manner I should not have expected. Whilst the walls and roofs of houses, garden-paths, and some trees appeared of a bluish grey, the lawns, the vines, ivy, jasmine, and Virginia creeper trained to the walls, and a large patch of lettuces n a kitchen-garden

appeared of a reddish bronze colour, and certain yellow doors (the conventional "oak-graining") became of a dull red. I do not know with what material the glass was coloured.—I am, &c.,

H. P. F.

"FAITH."

To the Editor of the Journal of Science.

SIR,—In the notice of this work in your August number (p. 489), your reviewer seems to have overlooked a mistake into which the author has fallen. Mr. Griffith writes (p. 163)—"Theorists had long contended that, to account for certain excentric phenomena with which they were familiar, there must be somewhere in Nature an unknown residual element which ever and again baffled their nicest calculations. They even ventured to describe minutely, *à priori*, more than one of its distinguishing properties, notwithstanding that the most careful observation had never been able to detect a trace of its positive existence. Happily by this time, thanks to the genius and perseverance of L. de Boisbaudran, the disturber has been caught *flagrante delicto*, in the precise shape and dress fore depicted, and is now recognised all over Science-dom as the new metal *Gallium*." Surely this is not a correct account of the discovery of the metal in question. Its existence was predicted by Professor Mendelejeff, not on account of any "excentric phenomena," but because, having tabulated the known elements, he found a certain gap, which, if filled at all, must be occupied by a body having properties intermediate between those of its nearest neighbours.—I am, &c.,

GORDIUS.

A REPLY.

IN reply to a querist we beg to say that the "Journal of Science" is not in any way an organ of medical opinion. It frequently happens, however, that the interests of Science, and especially of Biological Science, coincide with those of the medical profession, and in all such cases it is our duty not to keep silence.

NOTES.

Note on the Action of Salts of Alumina on White Sweet Peas. By A. Anthony Nesbit, F.C.S.—During the prosecution of the experiments on flowers (some notes on which were published in the July issue of the "Journal of Science") the following curious results have been obtained:—The stalks of some white sweet peas having been placed in a 10 per cent solution of potash alum, the petals after some hours turned a delicate pale yellow, and began to fade; the flowers were then taken out of the solution and pressed, and as they dried the yellow colour deepened. Ten per cent solutions of chloride, acetate, and sulphate of alumina were next tried, and in each case the yellow colour was developed in the petals of the peas, it being, however, strongest in the cases of the solutions of potash alum and the chloride of aluminium. White double primulas and white double stocks were then placed in 10 per cent solutions of the two first-mentioned salts; but while in the case of the primula the yellow colour was developed, in the case of the stock it was not. On a little further investigation it was found that if the petals of the white pea, or the white double primula, were mashed and moistened with a solution of any of the above-named salts of alumina, a bright pale yellow colour was at once produced. Stocks treated in the same manner turned a greenish yellow, although their flower had not altered in colour when placed in the solutions as described above. A number of sweet peas were then crushed, and their juice expressed, warmed, and filtered, when it became clear and nearly colourless. Strong solution of potash alum was then added, and the liquid became yellow. On the addition of ammonia the hydrate of alumina was precipitated, carrying down with it the whole of the colouring matter.

A report has been circulated that Sir David Lionel Salomons is the first inventor of the automatic electric system of railway-signalling. We beg to point out that he was in this matter anticipated by Mr. W. T. Whiteman, whose patent (No. 270, A.D. 1874) is dated January 22nd, whilst that of Sir D. L. Salomons is dated October 13th, or eight months later.

At the meeting of the Entomological Society, August 2nd, Mr. Pryer communicated a very important memoir on the butterflies of Japan with reference to seasonal, or rather temperature, varieties. Many species have two or three broods yearly, the specimens appearing in August being much larker and larger—sometimes double the size—than the March brood. At the

same time, in cold and elevated localities in the mountains, the small, light-coloured, spring forms appear throughout the summer.

In the discussion which followed Mr. Meldola pointed out that many species which are monomorphous in the north of Europe show an increasing tendency to vary as the summers are longer and hotter.

At the same meeting there was read an elaborate account of the Coleoptera of Ceylon, by Mr. Lewis. The island has three distinct faunæ, depending on altitude and on the presence or absence of jungle. The Coleoptera, even the Cicindelidæ and Carabidæ, haunt trees and plants, and, like almost all the local insects, have undergone corresponding modifications. Very few beetles are found under stones, the protection of fragments of bark or moss being sufficient. There appear to be no *Necrophaga*, all animal refuse being consumed by the ants. Lucanidæ are scarce, the indigenous timber being too hard and dry to support such large insects. Concerning Buprestidæ and Longicornes nothing was stated. Dung-beetles are generally absent. Nor are there any peculiar endemic forms. Many of the smaller *Geodephaga* have unmistakable European affinities. Mr. Pascoe, in comment, suggested that Ceylon might be a region where the Palæarctic and Indo-Malayan faunæ meet, but in our present ignorance of the Micro-Coleoptera of India this is mere matter of conjecture.

M. R. Zeiller (" Comptes Rendus ") has made an examination of the fossil carboniferous flora of Tonquin. The species found resolve themselves into two groups ; the one consisting of forms which have been long ago met with in Europe, whilst the other comprises specific types peculiar to India, Australia, and South Africa. It appears that in the carboniferous epoch there must have been two great and very distinct botanical regions, and the south of Asia marks their region of union.

It is said of two eminent official scientists in England that the one fancies himself a physician and the other a metaphysician.

According to Messrs. Liveing and Dewar (" Proceedings of the Royal Society," xxxiii., No. 219, p. 428) the spectra of metals become seriously modified when their vapours are mixed together. New lines or bands may appear, whilst others disappear. Hence the authors are of opinion that much remains to be done before it can be maintained that any of the solar lines are due to a non-terrestrial element.

Herr E. Albert (" Annalen der Physik ") calls attention to the changes in the tone of coloured solutions produced by a decrease in the intensity of light. Blue-violet in diminishing light appears violet, greenish blue becomes blue, greenish yellow turns green, pure greens remain unaffected.

According to M. Larbalétrier *Cecidomyia tritici*, a Dipterous insect belonging to the Nemocerida, destroyed, in 1855, 48 per cent of the wheat crop in several departments of the east of France, whilst in 1846 it destroyed more than two million hectolitres of wheat in Belgium, thus occasioning a loss of 40 million francs.

M. A. Vollant ("Cosmos les Mondes") produces the effects of grafting by a simple transfusion of the sap of the desired variety of fruit tree into a suitable stock. He gives his process the very ill-chosen name of "vaccination of plants."

According to the same journal the wines of the Gironde hold in solution a mean quantity of 63 milligrammes of iron per litre, a proportion surpassing that found in most ferruginous waters.

M. Ch. Musset ("Comptes Rendus"), after four years' observation at Grenoble, fully confirms the views of Darwin on the part played by insects in the fecundation of flowers. He testifies, in opposition to M. E. Heckel, that all orders of insects are represented up to 2300 metres above the sea-level; that at greater heights the Lepidoptera, Diptera, and certain Hymenoptera are more numerous than the other orders; that the number of genera, species, and individuals of nectarophilous insects is proportional to that of flowers, and is sometimes incalculable; the hours of the opening and sleep of nyctitropic flowers (much more numerous than is commonly imagined) are synchronous with those of insects. Flowers and insects never fail each other, and hence M. Heckel's objection to cross-fertilisation, based on the alleged absence or rarity of insects on the flowering mountain-tops, must fall to the ground.

M. Ch. Musset has observed that dew is one of the predominating causes of the temporary disappearance of insects. (This explains the ill success which attends "sugaring" for moths on moonlight nights).

Mr. Norman N. Mason ("American Naturalist") confirms the statements concerning the carnivorous character of the honey-bee (*Apis mellifica*). Dr. Fritz Müller has noticed several Brazilian honey-bees (*Mellipona varians, M. ceyrepie, M. gurupu*, and *Trigona pinguicosa*) licking the juice of fresh meat.

P. S. Legouis ("Comptes Rendus") maintains that the *Cyclostoma*, &c., have a distinct pancreatic apparatus like that of the *Teleostei*.

The Abbé Giotti Ulivi ("American Naturalist"), after prolonged observations on hive-bees, maintains that queens are usually fertilised inside the hive; that they are fertilised several times; that the drones are not mutilated in the act of copulation; that every egg that hatches into a male or female has

been previously fecundated. There is no such thing as a fertile worker, and, in fine, parthenogenesis in bees is a myth.

According to the same journal two beetles (*Doryphora juncta* and *Cassida texana*) have recently changed their habits, and become parasitic on the egg-plant.

Another of our eminent scientific men, and a contributor to this Journal, came to an untimely end on the 14th instant. Prof. W. Stanley Jevons was drowned whilst bathing near Bexhill, on the Sussex coast.

"Festina lente" gives, in the "Geological Magazine," a refutation of Prof. Ball's speculations on the results of the moon's action of the earth, substantially identical with that which he communicated to the "Journal of Science" in March last.

Herr Dueberg suggests that the moon may be habitable on the side invisible to us, the water and the atmosphere being withdrawn thither by the effects of gravitation.

Dr. Beard's interpretation of thought-reading as merely muscle-reading is placed in peril by Mr. Bishop's recent experiments. The latter gentleman, it is said, can now find a hidden object *without* any contact with the person who has concealed it. We may, however, fairly doubt whether this fact brings the great question between animism and "materialism" any nearer to a solution.

A truly venomous lizard (*Heloderma horridum*), a native of Mexico, has been received at the Zoological Gardens. All its teeth, above and below, are, like the two fangs of death-snakes, furnished with grooves, and are in connection with poison-glands. A frog and a guinea-pig bitten by the animal died in one and three minutes respectively. The possibility of a venomous saurian has hitherto been denied on the very feeble *à priori* ground that no case of the kind had hitherto come under the notice of men of Science. It may be asked whether the learned world is not sometimes too hasty in rejecting common traditions without examination.

According to M. Van der Berghe (Soc. de Med. de Gand.) wheat contains 9·24 parts of metallic copper per million, and oats 10·8 parts.

According to M. Dareste ("Comptes Rendus") monstrosities may be produced, in birds, by simply prolonging the interval between the laying of the eggs and the commencement of incubation.

Prof. Plósz and L. von Udràn ("Zeitschrift für Physiol. Chemie") have discovered a new crystalline colouring-matter in two samples of morbid urine. The new pigment is of a

bright violet-red colour, soluble in chloroform and ether, and distinguished from indigo which accompanies it by two distinct absorption bands, between D and E, though nearer to the former, and one between *b* and F, nearer the latter.

M. Le Bon (" Comptes Rendus ") shows that the emanations of putrid liquids are most dangerous to inhale after the odour of sulphuretted hydrogen has disappeared, and after their virulent action on subcutaneous injection has disappeared.

Dr. Greenley (" Louisville Medical News "), anent recent fasters, such as Dr. Tanner, remarks that the inferior animals, especially the pig, possess greater endurance in this respect than man. This power of endurance depends in a great measure on the fact that in the hog there is no (?) mental activity: hence the greater ability possessed by the imbecile to fast than by those whose mental faculties are in a normal condition.

The absurdity of the English law against vivisection is well illustrated by a remark of Sir James Paget. He says, " I may pay a rat-catcher to destroy all the rats in my house with any poison he pleases, but I may not myself, unless with a license from the Home Secretary, poison them with snake-poison."

According to Dr. Hewson (" Boston Journal of Chemistry ") the common European sparrow is capable of having and of communicating smallpox.

It is asserted (" New York Medical Journal ") that no authenticated case of rabies has ever occurred on the Pacific coast of America.

It is found that drunkenness is increasing in France just in proportion as wine is ceasing to be the national drink.

Prof. Spring, of Liege, finds that various bodies undergo important chemico-physical transformations at high pressures. Thus red phosphorus is converted into the black form at a pressure of 7000 atmospheres.

Dr. A. L. Adams, F.R.S. and F.G.S., who has been successively Professor of Natural History at Dublin and Cork, died since our last issue. He was well known for his " Wanderings of a Naturalist in India."

Prof. Ewart, the present occupant of the chair of Natural History at Edinburgh, does not find things working smoothly. We cannot, of course, presume to say where the fault lies, but it is reported that all the class assistants have resigned.

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